IMPROVING U.S. ARMY ANALYSIS OF ALTERNATIVES TO BETTER ADDRESS THE WEAPON SYSTEMS ACQUISITION REFORM ACT OF 2009

SSCF RESEARCH REPORT

May 2012

Thomas J. Stadterman
Senior Service College Fellowship

Project Adviser:
Ellen Barber
Senior Service College Fellowship
Defense Acquisition University
Aberdeen Proving Ground, MD

	Form Approved OMB No. 0704-0188

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE **MAY 2012**	2. REPORT TYPE	3. DATES COVERED **00-00-2012 to 00-00-2012**
4. TITLE AND SUBTITLE **Improving U. S. Army Analysis Of Alternatives To Better Address The Weapon Systems Acquisition Reform Act of 2009**		5a. CONTRACT NUMBER
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Defense Acquisition University,Senior Service College Fellowship,Aberdeen Proving Ground,MD,21010**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT **Same as Report (SAR)**	18. NUMBER OF PAGES **133**	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**			

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

IMPROVING U.S. ARMY ANALYSIS OF ALTERNATIVES TO BETTER ADDRESS THE WEAPON SYSTEMS ACQUISITION REFORM ACT OF 2009

SSCF RESEARCH REPORT

May 2012

Thomas J. Stadterman
Senior Service College Fellowship

Project Adviser:
Ellen Barber
Senior Service College Fellowship
Defense Acquisition University
Aberdeen Proving Ground, MD

TABLE OF CONTENTS

ABSTRACT

The U.S. Congress passed Public Law 111-23 (Weapon Systems Acquisition Reform Act (WSARA) of 2009), which significantly changed the way the U.S. Department of Defense (DoD) procures weapon systems. The WSARA of 2009 increases the role of the Office of Secretary of Defense (OSD) in the Services' Analyses of Alternatives (AoAs) through the creation of the Director, Cost Assessment and Program Evaluation (CAPE). Before Major Defense Acquisition Programs (MDAPs) Milestone (MS) Decisions, AoAs are performed to determine if an acquisition program is warranted to start or to continue to the next acquisition phase. The U.S. Army has performed several AoAs for Acquisition Category (ACAT) I programs since the passing of the WSARA of 2009. These AoAs have had varying degrees of success in meeting the expectations of OSD CAPE.

This report outlines the research to identify potential ways to improve U.S. Army AoAs to better meet the requirements of the WSARA of 2009 and the expectations of OSD CAPE. Key senior-level Department of the Army and OSD CAPE personnel associated with recently conducted ACAT I AoAs were interviewed, and their responses are presented in this report. Recommendations are provided on key aspects of U.S. Army AoAs to include the following: the major issues associated with AoAs under the WSARA of 2009, the relationship between OSD CAPE and the Army, the timing of conducting AoAs and other analyses, and the role of alternatives in AoAs. Special consideration was given to addressing the role of foreign nondevelopmental items in AoAs and the tradeoffs among cost, schedule, and performance.

CHAPTER 1
INTRODUCTION

This report outlines the research to determine how to improve U.S. Army Analyses of Alternatives (AoAs) to better meet the requirements of the Weapon Systems Acquisition Reform Act (WSARA) of 2009 and the expectations of the Office of Secretary of Defense (OSD) Director, Cost Assessment and Program Evaluation (CAPE). Key senior-level Department of the Army and OSD CAPE personnel associated with recently conducted Acquisition Category (ACAT) I AoAs were interviewed, and their responses are presented in this report. The report also provides recommendations to be made to the process.

Background

Before Major Defense Acquisition Programs (MDAPs) Milestone (MS) Decisions, AoAs are performed to determine if an acquisition program is warranted to start or to continue to the next acquisition phase. AoAs are statutory requirements for MS decisions based on Department of Defense Instruction (DoDI) 5000.02 (2008), United States Code (U.S.C.), Title 10 (2011) and U.S.C. Title 40 (2011). In 2009, the U.S. Congress passed Public Law 111-23 (WSARA of 2009), which significantly changed the way DoD procures weapon systems. The WSARA of 2009 increases the role of the OSD for AoAs by the creation of OSD CAPE. The organization of OSD CAPE must develop AoA guidance, and the Materiel Decision Authority (MDA) must certify that an AoA has been completed based on this guidance (WSARA of 2009). This increased scrutiny on the Services' AoAs has made it critical that the U.S. Army perform the AoAs consistent with OSD CAPE guidance. The WSARA of 2009 also has placed additional emphasis on tradeoffs between cost, schedule, and performance in AoAs.

Problem Statement

The U.S. Army has performed several AoAs for ACAT I programs since the passing of the WSARA of 2009. These AoAs had varying degrees of success in meeting the expectations of OSD CAPE.

Purpose of this Study

This study will identify potential improvements for U.S. Army AoAs to better meet the requirements of the WSARA of 2009 and the expectations of OSD CAPE. Recommendations are provided on key aspects of U.S. Army AoAs to include the following: the major issues associated with AoAs under the WSARA of 2009, the relationship between OSD CAPE and the

Army, the timing of conducting AoAs and other analyses, and the role of alternatives in AoAs. Special consideration will be given to addressing the role of foreign nondevelopmental items (NDIs) in AoAs and the tradeoffs among cost, schedule, and performance.

Significance of this Research

This research will help identify ways to improve U.S. Army AoAs to better meet expectations of OSD CAPE in order for the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) to certify that an AoA has been completed. Further, efficiency and effectiveness are improved with better AoAs. In the expected post-Operation Enduring Freedom Defense budget restrictions, the importance of quality AoAs is even more paramount. AoAs are needed for an MS A decision and potentially for MS B and MS C decisions. Without a certified AoA, the program cannot go to a MS decision. The AoA must be performed consistent with the guidance developed by OSD CAPE (WSARA of 2009) for MS A or any other MS.

Overview of the Research Methodology

This research utilized the interview method to collect data from senior-level Army leadership involved with AoAs and senior-level OSD CAPE personnel. The Army organizations were divided into two groups; including Army AoA team members and Army AoA oversight. Senior-level personnel are defined as Senior Executive Service (SES) personnel, colonels (COLs) (or O-6 equivalents), and General Schedule (GS)-15 (or equivalents). These senior-level personnel have been involved with U.S. Army AoAs since the passing of WSARA of 2009. Their involvement may have been developing guidance, reviewing, approving, or certifying U.S. Army AoAs.

Research Question

How can Army AoAs be improved to better meet the expectations of OSD CAPE under WSARA of 2009?

Research Hypotheses

There are two hypotheses for this research, which include the following:

1. U.S. Army AoAs can be improved to better meet the expectations of the OSD CAPE under the WSARA of 2009.

2. Senior-level Army and OSD CAPE personnel can identify potential improvements to Army AoAs to better meet WSARA of 2009 requirements and OSD CAPE expectations.

Limitations of the Study

This study was limited to U.S. Army AoAs for ACAT I programs. Other Service AoAs, or AoAs associated with ACAT II, III, or IV programs, are important but out of the scope of this research. This research was also limited by the number of people interviewed. Due to the constraints of completing the research by April 12, 2012, a selected group of senior-level U.S. Army and OSD CAPE individuals were interviewed.

Timeline for Research

The following are the key milestones for the completion of this research by the due date of April 12, 2012.

October 14, 2011—Sent draft research proposal to the project advisers and Mr. James Oman, Director, Aberdeen Proving Ground Senior Service College Fellowship Program.

November 30, 2011—Met with Mr. Robert Chandler, Chief, Weapons Systems Analysis Division, Army Materiel Systems Analysis Activity (AMSAA), to discuss research proposal.

November 30, 2011—Met with Mr. Patrick O'Neill, Technical Director, AMSAA, to discuss research proposal.

December 15, 2011—Met with Dr. William Forrest Crain, Director, AMSAA, to discuss research proposal.

December 31, 2011—Performed mock interviews with AMSAA personnel to refine questions.

January 9, 2012—Sent final research proposal to project advisers.

February 26, 2012—Sent first draft Strategic Research Project to project advisers.

March 16, 2012—Completed interviews.

March 26, 2012—Sent second draft Strategic Research Project to project advisers.

April 12, 2012—Final Strategic Research Project sent to project advisers.

Because of scheduling issues associated with the interviews, some interviews were conducted after the March 16, 2012 deadline. The last interview was conducted on April 2, 2012.

CHAPTER 2
LITERATURE REVIEW

This chapter provides the following: an overview of AoAs; an explanation of how the AoA process has changed under the WSARA of 2009; an overview how DoD is implementing the WSARA of 2009; U.S. Army initiatives to improve AoAs; and OSD CAPE suggestions for AoAs.

AoA Overview

AoAs are a required part in the DoD acquisition process as prescribed in Department of Defense Instruction (DoDI) 5000.02 (2008), U.S.C. Title 10, and U.S.C. Title 40. DoDI 5000.02 (2008) requires that AoA guidance be developed at the Materiel Development Decision (MDD) review by the Director, Program Analysis & Evaluation (DPA&E). The WSARA of 2009 created a new OSD office called OSD CAPE with a political appointee. OSD CAPE was designated to be the lead for the development of AoA guidance. The lead DoD component prepares an AoA study plan to assess materiel solutions, identify key technologies, and estimate life cycle costs (DoDI 5000.02, 2008). "The purpose of the AoA is to assess the potential materiel solutions to satisfy the capability need documented in the approved ICD [Initial Capabilities Document]" (DoDI 5000.02, 2008).

DoDI 5000.02 (2008) provides additional guidance on AoAs for the Materiel Solutions Analysis (MSA) Phase:

> The AoA shall focus on identification and analysis of alternatives, measures of effectiveness, cost, schedule, concepts of operations, and overall risk. The AoA shall assess the critical technology elements (CTEs) associated with each proposed materiel solution, including technology maturity, integration risk, manufacturing feasibility, and, where necessary, technology maturation and demonstration needs. To achieve the best possible system solution, emphasis shall be placed on innovation and competition. Existing commercial-off-the-shelf (COTS) functionality and solutions drawn from a diversified range of large and small businesses shall be considered (DoDI 5000.02, 2008, p. 15).

The MSA Phase ends when the AoA has been completed, and entrance into the Technology Development (TD) phase is dependent on the completion of the AoA. DoDI 5000.02

(2008) states that AoAs are a statutory requirements for MS A, MS B (updated as necessary), and MS C (updated as necessary) based on U.S.C. Title 10 (2011) and U.S.C. Title 40 (2011). In addition to fulfilling a statutory requirement for MS decisions, AoAs must also meet other requirements in U.S.C. Title 40 (2011) including process improvement to reduce costs, improve effectiveness, maximize the use of COTS equipment, and determine that no private sector or government organization can better support the function (DoDI 5000.02, 2008). OSD will ensure that AoAs have:

a. illuminated capability advantages and disadvantages;

b. considered joint operational plans;

c. examined sufficient feasible alternatives;

d. discussed key assumptions and variables and sensitivity to changes in these;

e. calculated costs; and

f. assessed the following:

(1) technology risk and maturity;

(2) alternative ways to improve the energy efficiency of DoD tactical systems with end items that create a demand for energy, consistent with mission requirements and cost effectiveness; and

(3) appropriate system training to ensure that effective and efficient training is provided with the system (DoDI 5000.02, 2008, pp. 58–59).

Weapon Systems Acquisition Reform Act of 2009

The WSARA of 2009 has altered the AoA process. As noted in the previous section, WSARA (2009) has created a Director, OSD CAPE and an organization OSD CAPE to develop guidance for AoAs for MDAPs and perform this analysis as directed by the Secretary of Defense. OSD CAPE combined the responsibilities of the previous Director, Program Analysis & Evaluation (DPA&E), and the Chairman, Cost Analysis Improvement Group (CAIG) (Brown, 2009). The OSD CAPE office also must "Review, analysis, and evaluation of programs for executing approved strategies and policies, ensuring that information on programs is presented accurately and completely, and assessing the effect of spending by the DoD on the U.S. economy" (WSARA, 2009, p. 4, § 139c.). OSD CAPE also has a significant role for independent cost analysis of DoD and the Services. This role is also related to AoAs, because cost estimation is a critical component of AoAs.

The AoA guidance must consider the following as a minimum:

(1) Full consideration of possible tradeoffs among cost, schedule, and performance objectives for each alternative considered.

(2) An assessment of whether or not the joint military requirement can be met in a manner that is consistent with the cost and schedule objectives recommended by the Joint Requirements Oversight Council (JROC). (WSARA, 2009, p. 18, Title II Acquisition Policy, SEC. 201)

WSARA (2009, p. 18, Title II Acquisition Policy, SEC. 201) also alters Section 2366a(a) of Title 10, U.S.C. (2011) by adding that the MDA must certify that "an analysis of alternatives has been performed consistent with study guidance developed by the Director OSD CAPE."

DoD Implementation of the Weapon Systems Acquisition Reform Act of 2009

To implement WSARA within DoD Components, the USD(AT&L) issued Directive-Type Memorandum (DTM) 09-027, December 4, 2009. DTM 09-027 (2009) amended the acquisition policy in the DoDI 5000.02 (2009), the Defense Federal Acquisition Regulation (DFAR) Supplement (DFARS) (1998), and the Defense Acquisition Guidebook (DAG). The directive states that "the OSD CAPE leads the development of study guidance for the AoA for each joint military requirement for which the Chairman of the JROC is the validation authority" (DTM 09-027, 2009, p. 3). The MDA initiates the AoA in the acquisition decision memorandum (ADM) from the MDD (i.e., the start of the MSA phase), and provides the OSD CAPE study guidance as an attachment (DTM 09-027, 2009). For ACAT ID systems, the USD(AT&L) is the MDA. The policy impact, as stated by DTM 09-027 (2009, p. 3), is that "The MDA directs initiation of the AoA, but no longer approves the AoA Study Guidance, which is now approved by the OSD CAPE." Also for an MDAP, the MDA must certify that all statutory requirements have been completed for MS A and MS B, including the conduct of an AoA.

On September 13, 2010, the USD(AT&L) issued DTM 10-017—Development Planning to Inform MDD Reviews and Support AoA. DTM 10-017 (2010) states the following:

"The DoD Components shall provide evidence at the MDD Review that will facilitate the MDA's determination that:

- "The candidate materiel solution approaches have the potential to effectively address the capability gap(s), desired operational attributes, and associated dependencies.

- "There exists a range of technically feasible solutions generated from across the entire solution space, as demonstrated through early prototypes, models, or data.

- "Consideration has been given to near-term opportunities to provide a more rapid interim response to the capability need.

- "The plan to staff and fund analytic, engineering, and programmatic activities supports the proposed MS entry requirements as identified in Reference (c)." (DTM 10-017, 2010, p. 2)

DTM 10-017 (2010) also directs that the Director, Defense Research and Engineering (DDR&E) cooperate with the Director, OSD CAPE, and be a participant and technical adviser in development of AoA Study Guidance to facilitate consideration of technology and engineering risks for the alternatives.

The Center for Strategic and International Studies developed an independent review of the implementation of WSARA and noted the following regarding OSD CAPE:

- Director, OSD CAPE position, was filled with Christine Fox on November 3, 2009.

- OSD CAPE leads and approves AoA study guidance.

- OSD CAPE provides policies and procedures for all DoD cost estimates.

- OSD CAPE reviews DoD Component cost estimates and analyses conducted for MDAPs and Major Automated Information Systems (MAIS).

- OSD CAPE conducts Independent Cost Estimate (ICE) and cost analyses for MDAPs and MAIS for which USD(AT&L) is the MDA (Berteau, Hofbauer, & Stephanie, 2010).

The important aspects in the DTMs related to AoA are the following: OSD CAPE has been created, OSD CAPE develops the guidance for MDAP AoAs, OSD CAPE is supported by DDR&E, technology and engineering risk are stressed, and that the MDA has to certify that an AoA was conducted.

U.S. Army Initiatives to Improve AoAs

There have been studies, articles, and white papers written about how to improve Army AoAs in response to WSARA. The Office of the Deputy Assistant Secretary of the Army for Cost and Economics (DASA-CE) performed a study to examine risk considerations in pre-MS A cost analysis, which would be used in AoAs. The summary and conclusions of this study are as follows:

- Pre-MS A estimates must be accompanied by risk/uncertainty ranges.

- Risk analysis pre-MS A should be assessed at a less granular level (i.e., development schedule risk, instead of schedule risk of development science, technology, and engineering [ST&E]).

- Typical risk analysis approaches can be tailored to pre-MS A, but highly detailed methods are rarely useful.

- Schedule risk analysis during the pre-MS A time frame can be particularly useful.

- "Over-specification" should be avoided and balance achieved between the competing demands of reasonable assumption-making and development of a "Cost Analysis Requirements Description (CARD)-like" level of detail.

- Methodologies and assumptions must be consistent among alternatives within an AoA in order to ensure maximum comparability (Roper, 2010).

Both the risk analysis (schedule and cost) and consistent methodology and assumptions for alternatives are important aspects of AoAs.

The Training and Doctrine Command (TRADOC) Analysis Center (TRAC) has developed white papers associated with AoA issues and recommendations. One of these white papers states that "AoA policy and guidance need to be readdressed to reconcile whether, what and why the AoA should report the same or very similar information that the PM [program manager] is obligated to report for the program" (TRAC, 2011a). This white paper addressed two problems associated with AoAs to include the following:

- The purpose and scope of the AoA are not clearly described and differentiated for each MS decision.

- The term, "materiel solution" is used repeatedly throughout existing AoA guidance, in some instances interchangeably with "alternative," without expressing a clear definition of what it represents and using language that suggests an inconsistently applied interpretation of "materiel solution" (TRAC, 2011a).

The white papers provide ideas for AoA purpose and scope for both MS A and MS B and suggest that AoA policy provides the specific decision issues. Suggestions are provided in the white paper for a distinction between the terms "materiel solutions" and "alternatives" in the context of AoAs.

Other Army papers and presentations outline improvements to analyses and AoA processes. Various presentations outline the need for analyses pre-MDD and to support the

requirements developmental process. Hume (2012) presents ideas for building an analytical framework for the capabilities development process. TRAC (2011b) presents recommendations to improve the Capabilities Based Assessment (CBA) process and to introduce new analysis prior to MDD. Other presentations provide recommendations associated with AoAs. The Army Capability Integration Center (ARCIC), TRAC, and AMSAA (2011) reviewed lessons learned from recently completed AoAs and provided recommendations on improving AoAs. Recommendations are related to the following: refining the purpose and scope of MS A and MS B AoAs, obtaining industry input for the MS A AoA, and assigning central responsibility for obtaining foreign system data.

OSD CAPE Suggestions for AoAs

OSD CAPE developed a presentation of the statute, policy, and recent practices associated with AoAs. The presentation outlines what an ideal AoA would provide and states that "AoA provides well-described and understood "options" for the decision-maker" (Duke & Kaspersen, 2011, p. 8). Duke and Kaspersen (2011, p. 8) lists the elements of an ideal AoA as the following:

- Prioritized, quantified, contextualized capability gaps.
- Feasible alternatives that are affordable and mitigate the capability gaps.
- The trades within and across alternatives among cost, schedule, and performance.
- Transparent analysis of recognized quality.
- Sensitivity analysis: How robust are the solutions?

Duke and Kaspersen (2011, p. 9) also list the enablers for an ideal AoA, which include "effective communications, trust, and shared vision of supporting the decision-maker must underpin all efforts." Also noted in the report is that a clear direction for the AoA is needed and any changes in direction should be relayed quickly to the Services. Duke and Kaspersen (2011, p. 9) also note that OSD CAPE must have "timely insight into on going work, supporting tools, and emerging results—enables OSD to understand results." Duke and Kaspersen note good practices for AoAs, which include the following:

- Service Executive Steering Body is formed and includes key stakeholders (e.g., requirements, acquisition, and resources).
- Sensitivity analysis performed to determine the dependence of results on key parameters.

- Cost and affordability boundaries established early in the analysis to screen out unaffordable candidates.

- OSD CAPE site visits to centers of analysis and open analyst interaction with OSD CAPE.

- Contractor information is well-protected to Source Selection Evaluation Board problems.

Husband and Kaspersen discuss the role of AoAs and OSD CAPE under WSARA of 2009 and provide recommendations on program cost and affordability analyses, interactions between OSD CAPE and AoA team, and interactions between requirements, acquisition, and resources communities. Husband and Kaspersen (2012, p. 1) define an AoA as "a structured, unbiased framework for systematically evaluating the most promising alternatives for a given need, comparing the relative merits and risks of those alternatives, and providing a recommended approach to decision-makers." They also describe the purpose of an AoA is "to fully evaluate and fairly compare the effectiveness and cost of all the viable alternatives" (Husband & Kaspersen, 2012, p. 4). Husband and Kaspersen discuss how cost and affordability should be considered earlier in the acquisition process. They note the challenge of performing a cost estimate at MS A, because the systems are not well-defined at that point. It is also noted that, "Senior leaders now expect the Services to be able to articulate how and why their recommended alternative is affordable, especially when the recommended option has a higher life cycle cost than lower performing alternatives" (Husband & Kaspersen, 2012, p. 3). Husband and Kaspersen also recommend that OSD CAPE and the Army AoA team work closer together, and the requirements, acquisition, and resourcing teams work closer together. "The AoA, more than any other acquisition document, is where the requirements, acquisition and resourcing communities come together to form a common view of which affordable alternative is the most desirable to pursue" (Husband & Kaspersen, 2012, p. 5).

CHAPTER 3
RESEARCH METHODOLOGY

Selected personnel were interviewed for this research, including senior-level Army leadership involved with AoAs and senior-level OSD CAPE personnel. Senior-level personnel are defined as SES personnel, COL (or O-6 equivalents), and GS-15 (or equivalents). These senior- level personnel have been involved with U.S. Army AoAs since passage of WSARA of 2009. Their involvement may have been developing guidance, reviewing, approving, or certifying U.S. Army AoAs. Members of the senior-level Army leadership involved with AoAs have a broad view of all the AoAs completed and sent to OSD. Their suggestions on how to improve the AoAs were drawn from their broad perspective. The OSD CAPE interviews yielded the customer perspective.

The interviews were completed in person or by telephone. The interview questions were sent beforehand to the interviewees so they could prepare for the interview. After the interview, the responses were sent back to the interviewee to ensure the correct meaning was captured.

The results of the interviews were divided into three areas: Army personnel associated with organizations conducting AoAs (i.e., the AoA team organizations); Army personnel associated with organizations providing oversight to AoAs; and OSD CAPE personnel associated with Army AoAs. The findings are divided into these three areas to compare U.S. Army and OSD CAPE responses to the interview questions.

Army AoA Team Interviewees

The section identifies the U.S. Army AoA Team interviewees, which include personnel leading organizations that perform work on AoAs. Interviewees from the following organizations were interviewed: TRAC, AMSAA, and the Office of DASA-CE. These organizations form the core team that performs AoAs. Other organizations work on AoAs, including the Research Development and Engineering Command (RDECOM), Army Research Laboratory (ARL), and Research, Development and Engineering Centers (RDECs). Many other organizations support AoAs, including Program Executive Officers (PEOs), PMs, TRADOC Centers of Excellence (COEs), the Army Staff, and the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT)). The interviews were limited to TRAC, AMSAA, and the office of DASA-CE because of time constraints.

TRAC typically is the Army lead for AoAs, and it performs the following analyses: force-on-force modeling; combat effectiveness; operational effectiveness; sustainment; Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities (DOTMLPF); gap; transportability; and a portion of cost. AMSAA is a member of the AoA team, and it performs the following analyses: performance, including survivability, force protection, lethality, mobility, fuel consumption, sensors, electronic warfare, communications, network, and chemical/biological; logistics, including reliability, Class IX spares, and fuel consumption; growth; risk assessment, including schedule and technical; and trades, including cost, schedule, and technology. The Office of the DASA-CE is a member of the AoA team, and it performs cost analysis, cost risk analyses, and trades analyses.

The population of interviewees includes SESs that are most closely involved with Army AoAs and select COL and GS-15 level personnel involved in AoAs. The COL and GS-15 personnel were selected because they have been, and continue to be, involved in multiple U.S. Army AoAs. The name, rank, organization, and position are provided below for each person interviewed.

Dr. William Forrest Crain, Director, AMSAA—(SES)

Mr. Michael Bauman, Director, TRAC—(SES)

Mr. Patrick O'Neill, Technical Director, AMSAA—(SES)

Ms. Pamela Blechinger, Director, TRAC Fort Leavenworth (FLVN)—(SES)

Dr. Garry Lambert, Director, TRAC White Sands Missile Range (WSMR)—(SES)

Mr. Stephen Barth, DASA-CE—(SES)

COL Douglas Hersh, Deputy Director, TRAC WSMR

COL Bradley Pippin, Deputy Director, TRAC FLVN

Mr. Robert Chandler, Chief, Weapon System Analysis Division, AMSAA

Mr. Frank Decker, TRAC FLVN

Mr. Rod Eaton, TRAC WSMR

Mr. Scott Schoeb, Chief, Maneuver Systems Branch, AMSAA

Mr. Alan Dinsmore, Integration Team Leader, AMSAA

Mr. David Henningsen, Office of the DASA-CE

Mr. Morteza Anvari, Office of the DASA-CE

Mr. Sean Vessey, Office of the DASA-CE

Ms. Alison Tichenor, Office of the DASA-CE

Army AoA Oversight Organizations Interviewees

The section identifies the interviewees from U.S. Army AoA oversight organizations, which include the Military Operations-Capabilities Integration (DAMO-CI), Deputy Chief of Staff (DCS), G-3/5/7 and ARCIC. These organizations provide oversight to Army AoAs. DAMO-CI, DCS G-3/5/7 provides draft AoA guidance to OSD CAPE, directs Army organizations to perform the AoAs, and reviews the AoAs. ARCIC directs Army organizations to perform the AoA and reviews the AoAs.

The population of interviewees includes SESs that are most closely involved with Army AoAs and select colonel and GS-15 level personnel involved in AoAs. The colonel and GS-15 personnel were selected, because they have been, and continue to be, involved in multiple Army AoAs. The name, rank, organization, and position are provided below for each person interviewed.

Dr. David Markowitz, Director, DAMO-CI DCS G-3/5/7—(SES)

Mr. Allan Resnick, Director of Assessment, Architecture & Mission Command Directorate, ARCIC—(SES)

COL Robert Hume, Chief, Studies and Analysis, ARCIC

COL Richard Holdren, Division Chief, Operations Research/Systems Analysis, DAMO-CI DCS G-3/5/7

Mr. Michael Moore, Deputy Director, DAMO-CI Prioritization and Analysis, DCS G-3/5/7

OSD CAPE Interviewees

This section identifies the OSD CAPE interviewees. The following personnel were interviewed from OSD CAPE to gain the AoA customer perspective. Each of these interviewees has been involved with Army AoAs. The majority of Army AoAs are coordinated through the OSD CAPE Land Forces Division, which reports to the OSD CAPE Deputy Director for Program Evaluation.

Dr. Scott Comes, OSD CAPE Deputy Director for Program Evaluation (SES)

Ms. Elaine Simmons, Director, Land Forces Division (SES)

Mr. Keith Kaspersen, Land Forces Division

Mr. John Duke, Land Forces Division

Dr. Eric Fulmer, Land Forces Division

Mr. Chuck Allen, Command, Control, Communications, and Computers (C4) and Information Programs Division

Interview Questions

Each person interviewed for this research was asked the following questions:

1. Briefly explain in your own words the purpose of an AoA.

2. What do you think are the major issues associated with AoAs under the new WSARA guidance?

3. How do you think AoAs should be tailored for different MSs?

4. What types of analyses do you think need to be performed in AoAs to meet OSD CAPE expectations?

5. How do you think definitions of the alternatives should be developed?

6. How do you think foreign system alternatives should be considered in AoAs?

7. How do you think the tradeoffs between cost, schedule, and performance should be considered in AoAs?

8. What would you do differently in future AoAs to better meet OSD CAPE expectations?

The interview answers were written and submitted back to the interviewee for any modifications, additions, or deletions.

CHAPTER 4
INTERVIEW RESULTS

This chapter provides the results of the Army and OSD CAPE interviews. A summary is provided of interview answers for each of the eight questions. The Army AoA team, Army AoA oversight organizations, and OSD CAPE answers are provided separately so they can be compared.

Summary of Army AoA Team Interviews

This section provides a summary of the Army AoA team interviewees. A summary of the interview's key points are provided for each question as bullet points. Appendix A, Army AoA Team Organizations Interview Results, expands on these key points by providing the interviewees' specific points.

1. *Briefly explain in your own words the purpose of an AoA.*

- The purpose of AoAs is to frame the decision space and to identify the best investment strategy and acquisition option. There is no best alternative, but rather a best acquisition decision.

- The purpose of AoAs is to inform the decision-makers on best investment courses of action.

- The purpose of an AoA is to identify the most affordable, cost-effective solution through tradeoff and cost-benefit analyses.

- The purpose of AoAs is to inform decision-makers on benefits of materiel solutions to meet capability gaps.

- AoAs are used to determine required performance levels and desired attributes through cost, schedule, and performance trades.

- AoAs are comprised of cost, schedule, and performance analyses on potential materiel solutions.

- AoAs should support the acquisition community by identifying the cost, schedule, and performance risks.

- AoAs should be unbiased with no preferred solution, informed about the funding available, and aligned to national security, defense, and military strategies.

- Analyses should be performed before the MS A AoA to identify capability gaps. The AoA should start as soon as a materiel solution is identified.

2. *What do you think the major issues are associated with AoAs under the new WSARA guidance?*

- WSARA has had a positive impact on AoAs by increasing the importance of analysis in MS decisions. Under WSARA, AoAs have to be more accurate, detailed, and unbiased. AoAs can better support the requirements development process.

- WSARA has increased OSD CAPE's influence in the AoA process. OSD CAPE provides the AoA guidance to the Services and determines if the AoA has been completed per their guidance. WSARA also requires that the DAE [Defense Acquisition Executive] certifies that the AoA has been completed in accordance with the OSD CAPE guidance. WSARA also provided a political appointee to lead OSD CAPE.

- WSARA has also caused friction between different organizations in OSD including USD(AT&L), OSD CAPE, Policy, and the JS (JS).

- Under WSARA, tradeoff analysis for cost, schedule, and performance are required across and within alternatives. The trades are at the system and subsystem levels, and they are conducted throughout the AoA. WSARA has dictated cost, schedule, and performance trades across and within the alternatives.

- WSARA requires technical/performance, cost, and schedule risk analyses. The risk analysis is associated with the cost, schedule, and performance tradeoff analysis.

WSARA has increased the emphasis on cost and schedule analyses in AoAs.

- Under WSARA, the scope of AoAs has increased. Cost, schedule, and performance must be estimated, traded, and assessed for risk. The tradeoff analyses and OSD CAPE guidance have increased the number of alternatives.

- Because of the increased complexity and interest in AoA from WSARA, the Army has experienced an increased workload in the analytical community. This increased workload requires additional analysts (cost and performance) and funding to support conducting AoAs.

3. *How do you think AoAs should be tailored for different MSs?*

- AoAs should be tailored specifically to the program, the decision space, and the different MS decisions.

- More information and data are available for the later MS AoAs as opposed to the MS A AoAs. The resolution of the alternatives is greater, and there is more knowledge of the performance.

- As a system progresses through MS A, MS B, and MS C decisions, the program (i.e., budgets and timelines) becomes more concrete and constrained. There are more tradeoffs between cost, schedule, and performance at MS A.

- There are more alternatives and courses of action at MS A than MS B. MS A AoA should consider a wide range of technologies and systems.

- The detail, fidelity, and robustness of analyses in AoAs increase from MS A to MS B and MS C. More detailed scenarios are used as the program progresses.

- At MS A, the AoA should include a thorough tradeoff analysis of cost, schedule, and performance. The MS A AoA should model a set of attributes as an alternative, and the alternative should not be associated with a system. At MS A, alternatives can serve as vessels to hold the attributes together to provide a better understanding of the interdependencies of attributes. Performance and cost estimates will have to be quickly made for the evolving alternatives. First-order estimates of performance and cost will have to be made.

- The tradeoff analyses continue at the beginning of the MS B AoA, but later in the AoA the alternatives should be solidified. The MS B AoA would compare the alternatives to the requirement and to each other. The MS B AoA should consider broader acquisition options to fulfill the needs.

- Although WSARA does not require a new AoA for each MS decision, conducting AoAs for each MS decision would be beneficial. Having formal AoAs at the later MSs would increase the fidelity and structure of the analysis and would increase the information flow for the analyses.

- It would be beneficial to obtain input from industry for MS A.

- AoA analysts must have better understanding of their customers, stakeholders, and external operating environment.

4. *What types of analysis do you think need to be performed in AoAs to meet OSD CAPE expectations?*

- Tradeoff analyses between cost, schedule, and technology/performance should be performed throughout the AoA. The trade space must be fully explored.

- Risk assessments should be conducted for cost, schedule, and technical.

- AoAs must address cost vs. benefits and cost vs. performance/effectiveness.

- AoAs should consider Operations and Support (O&S) cost and Life Cycle Cost (LCC) in addition to the unit costs.

- AoAs should consider other aspects besides effectiveness, such as the following: reliability, DOTMLPF, strategic impacts, transportability, maintainability, manpower analyses, force structure impacts, and squad size impacts.

- AoAs should include the following types of analyses: mission effectiveness, performance, cost, affordability, tradeoff (cost, schedule, performance/technology), sensitivity/ parametric, risk (cost, schedule, and technical), growth assessment, sustainment, fuel consumption, energy consumption, DOTMLPF, fleet strategy, and portfolio.

- The analyses must be transparent, open, and understandable to OSD CAPE. The analyses have to address OSD CAPE's decision choices and "tipping points." Analyses have to be objective, robust, and credible.

- OSD CAPE guidance drives the types of analyses performed in AoAs, but the guidance is not consistent across AoAs.

5. *How do you think definitions of the alternatives should be developed?*

- There are four basic types of alternatives to include the system in service, modifications of the system in service, NDI/foreign systems, and new start programs.

- A screening analysis conducted during the AoA would be beneficial in determining an initial set of alternatives. The screening analyses start with a broad look for possible alternatives and reduce the number of alternatives, based on criteria.

- OSD CAPE plays a significant role in the development of alternatives. OSD CAPE provides the AoA guidance and chairs the Senior Advisory Group (SAG), which approves the alternatives. OSD CAPE should not be involved with the Services' force design.

- The number of alternatives should be managed to a reasonable number (six or fewer) to complete the AoA in the 9- to 12-month timeframe. Alternatives should be eliminated if

they are determined to be infeasible, and there should be a limited number of "special interest" systems.

- Defining alternatives is both a top-down and bottoms-up process. The top-down process is based on guidance from Army and OSD leadership, and the bottoms-up approach is based on a screening analysis.

- For MS A, the alternatives should be attribute-based and developed by the materiel developer, user, analyst, and industry.

- Alternatives could be a mix of different systems for the fleet. An alternative could include some new start systems for a portion of fleet and some modified systems for the remainder of the fleet.

- There are more alternatives in an MS A AoA.

- There were other points identified for the process of defining alternatives.

6. *How do you think foreign system alternatives should be considered in AoAs?*

- For foreign systems, it is difficult to obtain the level of data needed for AoA performance and cost analyses. Foreign countries or companies are not willing to share detail data on their systems, because they don't believe the United States will purchase them. At some point, data might be available for one configuration, but not the configuration the AoA requires.

- Foreign systems should be identified and agreed upon early in the AoA process. The data and information request process should start early.

- The AoA team should not have the responsibility to obtain the data for foreign systems.

- An Army PM is required to develop a notional schedule for the foreign alternative as input into the tradeoff and risk analyses.

- All foreign systems will require some level of modification to address U.S. standards, U.S. government-furnished equipment (GFE) (e.g., radios), or U.S. manufacturing sites. Modifications may also be required to meet desired capability. The cost and schedule of these modifications would have to be included in the AoA.

- There are risks associated with using foreign systems such as compatibility, interoperability, and sustainment. These risks must be considered in the AoA.

- The United States rarely buys foreign systems because of political reasons and industrial base reasons.

- Foreign alternatives should be considered appropriately based on the information/data available. There may be greater uncertainty in the analytical results of foreign systems. This uncertainty should be understood by the AoA customers.

- The number of foreign alternatives should be limited (to one or two), because of the analytical resources to evaluate them.

- Foreign systems should not be considered if they are not viable, feasible candidates.

7. *How do you think the tradeoffs between cost, schedule, and performance should be considered in AoAs?*

- The trades are between cost, schedule, and technology. These trades would result in a level of performance. Tradeoff analyses involve parametric analyses where technologies are added or removed to the alternatives.

- A systematic approach to the tradeoff analysis should be developed and used for AoAs.

- Affordability analysis should be conducted to determine a cost target range, which can be used in the tradeoff analyses.

- The tradeoffs must be done within the context of the decision space.

- Operational effectiveness and performance analyses are required to perform the tradeoff analyses.

- It is difficult to consider schedule trades in the tradeoff analysis. The desired timeline for the development of the system may preclude changing the schedule. There is a lack of realistic schedule estimation, and schedule variations greatly affect cost.

- The tradeoff analysis should be done before an AoA, upfront in the AoA process or throughout the AoA process.

- The tradeoff analysis will become difficult with multiple alternatives to consider.

- Risk assessments are part of the tradeoff analyses. The relationship between cost, schedule, and performance must be understood.

- Risk methodology should have different approaches to consider past systems/components and new system/components.

- Tradeoff analyses allow more robust, cost-effective solutions to be developed.

- The tradeoff analyses affect the requirements generation process. Tradeoffs can be used to determine the minimum requirements to reduce cost and maintain schedule. The Joint

Capabilities Integration and Development System (JCIDS) process should also consider trades before an AoA is conducted.

- Currently, cost is the most important factor in the decision space.

- For the tradeoff analysis, LCC should be considered rather than only procurement costs.

8. *What would you do differently in future AoAs to better meet OSD CAPE expectations?*

- The Army should involve OSD CAPE early in the AoA process. The Army must understand OSD CAPE's guidance, and OSD CAPE must understand the Army's proposed study plan. The Army should be proactive in writing draft AoA guidance for OSD CAPE's consideration.

- The Army must increase the open and transparent communication with OSD CAPE during the AoA. The Army must share information and explain the analyses to OSD CAPE often during the AoA process. The Army must work closely with OSD CAPE to increase their level of understanding of the analysis so they understand that the analysis is credible and relevant.

- The Army must ensure the AoA results are presented in an unbiased manner. The Army should involve OSD CAPE in the interpretation of results. There should be no preferred alternatives in AoAs.

- AoA analyses and results must be related to OSD CAPE decision choices. The decision choices are not necessarily alternatives. AoAs must inform and enable decisions and be focused on the decision space.

- There should be an agreed-upon set of alternatives and a hierarchy established within this set to ensure analyses is performed on them.

- The scope of an AoA should be reduced as it progresses. The number of alternatives should be reduced by the SAG if the alternatives are no longer feasible or do not add to the decision choices. Analyses that do not add information relevant to the decision should be stopped.

- AoAs must explore trade space for cost, schedule, and performance. Risk assessment should be conducted for cost, schedule, and technical (including integration).

- A coherent, robust risk and trade methodology must be developed by the Army. AMSAA is currently working on this approach, and DASA-CE has a tool to support trades.

- Cost methodology should be refined to develop more estimating relationships that link performance to cost, incorporate risk better, and consider affordability.

- Conducting formal AoAs for each MS decision would increase the fidelity and structure of the analysis and would increase the information flow for the analyses.

- The MS A AoA results should be used to develop the Capability Development Document (CDD).

- There are funding challenges associated with the conduct of AoAs.

- There should be realistic schedules for conducting AoAs.

- The Army needs better unity of purpose.

- The Army should examine Navy and Air Force AoAs that OSD CAPE believes are well done.

- Other recommendations were made to improve AoAs.

Summary of Army AoA Oversight Organizations Interviews

This section provides a summary of the Army AoA oversight organizations interviewees. A summary of the interview key points is provided for each question as bullet points. Appendix B, Army AoA Oversight Organizations Interview Results, expands on these key points by providing the interviewees' specific points.

1. *Briefly explain in your own words the purpose of an AoA.*

- AoAs should support the requirements development process. AoAs also should support multiple customers in the requirements development and acquisition communities.

- OSD CAPE is focused on supporting MS decisions with AoAs rather than supporting requirements development or acquisition processes.

- AoAs should inform decisions regarding acquisition (including cost and schedule), requirements, and resource allocation.

- Formal AoAs at the later MS decisions are needed to support all the decision points throughout the acquisition process. There are too many unknowns early in the program for an MS A AoA to answer all the questions.

- The purpose of an AoA is to develop the supporting evidence to identify an achievable, affordable, and operationally relevant set of attributes. Alternatives are the "stalking horses" to better understand the set of attributes. Alternatives are the surrogate system that allows analysis to be conducted on a set of attributes.

2. *What do you think the major issues are associated with AoAs under the new WSARA guidance?*

- Completing an AoA at MS A is too early, but completing a detailed AoA at MS B is too late. The correct timing for an AoA is at the Preliminary Design Review (PDR).

- AoAs should not try to answer questions that are already being answered in the acquisition process (e.g., source selection).

- The requirements and acquisition communities are also customers of AoAs in addition to OSD CAPE. AoA should benefit all stakeholders and not only focus on OSD CAPE.

- Capability gaps and Concept of Operations (CONOPS) should be developed before the start of an AoA.

- Timely OSD guidance and adequate AoA study plans are needed.

- WSARA gave OSD CAPE more influence on AoAs, because OSD CAPE has to declare an AoA sufficient to support MS decisions.

- WSARA specifies that the AoA should cover cost, schedule, and performance tradeoffs. Requirements can be traded.

- Army AoAs have increased emphasis focus on measurement space and cost-benefit analyses.

- WSARA has increased the workloads of the analytical community, and the Army may not have the resources (funding or personnel) to perform detailed AoAs. A central funding source should be available for AoAs.

- The Army does not have enough analysts skilled in technical risk assessment, cost analyses, or affordability assessments.

3. *How do you think AoAs should be tailored for different MSs?*

- AoA must be tailored to the specific program, requirements, and problems.

- The timing of AoAs is not well coordinated with the acquisition process. Cost, schedule, and performance trades at MS A are too early and at MS B are too late; the PDR would be better timing for an AoA.

- It is not practical to have one AoA to support all MS decisions.

- There should not be an AoA associated with every MS.

- Before MDD, pre-AoA analyses must identify the capability gaps, threats, problems, attribute trade space, and feasible alternatives.

- For MS A, the AoA should inform the requirements by evaluating the cost, schedule, performance, and risk of the concepts; determining a set of achievable, affordable, and operationally relevant attributes for the system; and identifying affordable, operationally acceptable solutions.

- For MS B, the AoA should identify cost drivers, conduct cost-performance trades, support CDD development, and support the PDR. The AoA should also answer the question of whether or not to build the system.

- At MS C, the AoA support provides information to support a fielding decision for the system and address affordable distribution of the system.

- AoAs should identify the cost of capabilities and how much the capabilities can be reduced to make the system more affordable.

4. *What types of analysis do you think needs to be performed in AoAs to meet OSD CAPE expectations?*

- Gap analyses must be conducted to provide a basis for the AoA. The AoA must assess various ways to fill the gap.

- Comprehensive cost, schedule, and performance tradeoff analyses should be conducted in an AoA. Risk analyses should also be conducted. Risk estimates can be associated with the given cost, schedule, and performance, or it can be associated with the trades.

- AoAs should concentrate on determining a set of achievable, affordable, and operationally relevant attributes that mitigate an operational problem.

- AoAs should develop cost estimates including Average Procurement Unit Cost (APUC), Average Manufacturing Unit Cost (AMUC) and LCC.

- AoAs should not address the acquisition strategy, the number of contractors, how to build the system, or the Technology Demonstration feeds into engineering design.

- It is more difficult for the Army to meet OSD CAPE expectations than the Air Force or Navy. The Air Force and Navy's materiel solutions are more closely related to the strategic level than the Army's. OSD CAPE is more focused at the strategic level.

5. *How do you think definitions of the alternatives should be developed?*

- The definition of the alternatives should be tailored to the capabilities of the system.

- Analyses should be conducted before MDD to determine alternatives.

- Screening analysis is beneficial to determine the alternatives.

- Cost, schedule, and performance trades should be conducted within the alternatives.

- Parametric analysis should be performed to determine the most important attributes.

- AoAs should compare cases rather than alternatives. Cases are examples of alternatives.

- Alternatives represent "stalking horses" to identify an achievable, affordable, and operationally relevant set of attributes. The purpose of having alternatives is to identify these attributes.

- The Army should work closely with OSD CAPE to obtain agreement on the alternatives.

6. *How do you think foreign system alternatives should be considered in AoAs?*

- Foreign systems should be considered as equivalent to U.S. systems with the same fidelity of data.

- Foreign systems represent NDI cases—therefore, they should not be modified.

- For statutory reasons, the United States may not purchase a foreign.

- Foreign systems should only be considered in AoAs for comparison purposes only to investigate capabilities and attributes.

- Foreign systems will have to be modified to meet U.S. standards.

- Foreign systems should be discussed with OSD CAPE early in the AoA process to determine how they will be considered.

- A "concept vehicle" approach to developing systems could enhance AoAs.

7. *How do you think the tradeoffs between cost, schedule, and performance should be considered in AoAs?*

- Tradeoff analyses should be tailored to the capability, maturity, and cost of the system.

- Trades should be performed within and among alternatives to address the decision space.

- The tradeoff analysis will support the requirements development process, including the needed attributes.

- Risk assessment should be performed on tradeoffs between cost, schedule, and performance.

- There were differing priority of factors including cost, schedule, and performance and performance, cost, and schedule.

8. *What would you do differently in future AoAs to better meet OSD CAPE expectations?*

- AoAs must address the decision process and provide utility to the decision-makers.

- AoAs must satisfy all the customers including OSD CAPE, the acquisition community, the requirements community, and the portfolio mix community.

- AoAs must address OSD CAPE guidance and issues.

- The Army must engage OSD CAPE earlier in the AoA process. The Army must be candid and open with OSD CAPE.

- The AoA guidance should only include three points: (1) the purpose for the AoA; (2) when the AoA results are needed; and (3) identify the key angst/friction/concern points or issues.

- Army requirements must be developed with the support of analyses.

- The Army needs more analytic capability to address AoAs.

- The Army could utilize a "concept vehicle show" for industry to demonstrate their technologies.

Summary of OSD CAPE Interviews

This section provides a summary of the OSD CAPE interviewees. A summary of the interview key points is provided for each question in bullet points. Appendix C, OSD CAPE Interview Results, expands on these key points by providing the interviewees' specific points.

1. *Briefly explain in your own words the purpose of an AoA.*

- There are numerous purposes to an AoA, including providing information to inform acquisition decisions, exploring the trade space of cost schedule and performance, and answering the "Why" questions.

- There are desired characteristics of the options and alternatives to include: objectivity, nonpreferential options, affordable alternatives, and a robust set of alternatives.

- The analyses should back up a recommended solution, show due diligence, explain the trade space, include sensitivity analysis, and consider the positive and negative aspects of each option.

- The results of the AoAs should inform requirements, identify cost-effective solutions, be transparent, and consider operational effectiveness.

2. *What do you think the major issues are associated with AoAs under the new WSARA guidance?*

- OSD CAPE has an increased level of responsibility for AoAs under WSARA including: issuing AoA guidance; determining if the AoA was performed consistent with OSD CAPE's guidance; and recommending AoA updates.

- There is a new requirement under WSARA to perform cost, schedule, and performance trades. AoAs must ensure that the trade space is explored in detail.

- WSARA has increased the visibility of AoAs, which has resulted in a greater awareness and interest in AoA results. The JS, the Services, Congress, and Government Accountability Office (GAO) are inquiring about the results of AoAs.

3. *How do you think AoAs should be tailored for different MSs?*

- An AoA is required at MS A and there is one set of guidance, which is good for all MS decisions. The guidance will supply questions to be answered, and the AoA team should answer the questions to their best ability with the information available.

- An AoA does not have to be updated for the subsequent MSs unless OSD CAPE designates an update is required. An AoA may have to be updated for the following reasons: (1) the underlying assumption/facts change, (2) a new threat is identified, and (3) the program changes acquisition categories that change the MDA (e.g., from the Army Acquisition Executive (AAE) to the Defense Acquisition Executive (DAE)).

- AoAs may be required at later MS decisions for (1) a program going directly from MDD to MS B or post MS B, or (2) a program that changes ACAT levels.

- AoAs should be tailored to the specific program rather than for the MS. The analyses are tailored for the particular program rather than for the MS.

4. *What types of analysis do you think need to be performed in AoAs to meet OSD CAPE expectations?*

- The analysis should be quantitative instead of qualitative judgment-based. Using Subject Matter Experts (SMEs) to determine how much they desire a particular attribute, scoring the results, and developing weighing factors is not the correct process.

- The analyses must be understandable, transparent, and support the conclusion.

- Exploratory analysis and cost, schedule, and performance trades are important components to an AoA.

- Sensitivity analyses should be performed for the assumptions, alternative definitions, and drivers. For the "lesser" alternatives, sensitivity analyses should be performed to determine what it would take to make it a more competitive alternative.

- The analyses should identify "tipping points" for the decision choices. If there are no tipping points or points of interest, the AoA should "stop drilling," when the result does not make a distinction between alternatives.

- The following analyses should be conducted in AoAs: operational effectiveness, operational assessments, performance, cost, sensitivity, fully burdened cost of fuel, and affordability/portfolio.

5. *How do you think definitions of the alternatives should be developed?*

- The basic alternatives for AoAs include a baseline of what is currently programmed in service, a modification of what is currently in use, a NDI system/foreign system, and a new start system.

- There should be a broad search for alternatives, and the definition of those alternatives should be kept broad. The Service should not presuppose an answer and prematurely reduce the decision space.

- A robust screening analysis should be completed upfront and presented to the SAG, which will request additional excursions, and reframe or expand the analysis, as necessary.

- The alternatives should cover the decision space, and that trades and sensitivity analyses should be performed. A good screening analysis would help explore the trade space.

- The Services should follow the OSD CAPE study guidance when developing alternatives.

6. *How do you think foreign system alternatives should be considered in AoAs?*

- Foreign systems should be considered in AoAs, and the Services should do their best to obtain data and information. Systems from threat countries should not be considered.

- The decision to actually purchase a foreign alternative is not OSD CAPE's or the AoA team's decision.

- The cost and time associated with modifying foreign alternatives should be considered in the AoA.

- Another purpose of considering foreign alternatives is to learn more about their features, attributes, technical feasibility, and cost.

7. *How do you think the tradeoffs between cost, schedule, and performance should be considered in AoAs?*

- The tradeoff analysis should explore the trade space and decision space for AoAs. The boundaries for the trade space should be expanded to ensure a robust decision space. The trades should be explored throughout the AoA.

- AoAs should include performance vs. cost curves.

- The priority of tradeoff factors are performance, schedule, and then cost.

- Operational effectiveness is needed in the tradeoff analysis, and the CAIG should be included in the cost estimates.

- AoA should inform the CDD; although the CDD should not be written to make one alternative appear better.

8. *What would you do differently in future AoAs to better meet OSD CAPE expectations?*

- OSD CAPE desires more transparency, visibility, understanding of the analyses and assumptions.

- AoAs should not focus on one preferred alternative. The preferred alternative may not be attainable or viable, and a program based on this alternative may be canceled in later years.

- The following items should be included in AoAs:
  - Cost-effectiveness analyses
  - Real-world test results
  - Real-world foreign alternatives
  - Early identification of cost and performance drivers
  - Operational effectiveness to cost graphs
  - Sensitivity analyses on the assumptions
  - Consideration of the resources available, requirements, and acquisition process

- Cost and schedule should be considered when developing requirements.

- AoAs should be streamlined to reduce the cost of conducting the AoAs.

Summary of Results

This chapter provided the results of the Army and OSD CAPE interviews. A summary of interview answers for each of the eight questions were provided in this chapter. The Army AoA team, Army AoA oversight organizations, and OSD CAPE answers were provided separately so they can be compared. All Army and OSD CAPE personnel provided detailed, insightful answers to the AoA questions. This chapter only provided a summary of the interview results. Appendixes A, B, and C provide additional information to the summary points listed in the chapter.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a discussion of the interview results, comparison of interview results, and recommendations for improving Army AoAs. The discussion is divided into three sections, including discussions of the Army AoA team interview results, the Army AoA oversight organizations interview results, and the OSD CAPE interview results. After these discussions, the interview results will be compared across the three groups. Recommendations are provided to better meet OSD CAPE expectations and to better support the materiel requirements and acquisition processes. The chapter also includes limitations, implications for further research, and summary and conclusions.

Discussion of Army AoA Team Interview Results

Many of the Army AoA team's purposes of AoAs were related to providing information to the decision-makers. The Army AoA team noted that AoAs were to frame the decision space and to identify the best investment strategy and acquisition option. The idea of comparing best investment courses of action was proposed. Other personnel from the Army AoA team noted that OSD CAPE's decision choices are not necessarily alternative-related.

Army AoA team personnel noted OSD CAPE's influence has increased in the AoA process. Some noted the WSARA focus on AoA had a positive impact on AoAs. The Army AoA team said AoAs should be unbiased with no preferred solution and advocated the analyses must be transparent, open, and understandable to OSD CAPE. Having an unbiased AoA with no preferred solution also was a theme throughout the answers. The Army AoA team suggested that OSD CAPE be included early, and often, in the AoA process. By working more closely with OSD CAPE, OSD CAPE's level of understanding of the analysis would increase. OSD CAPE would more likely believe the analysis is credible and relevant.

The Army AoA team personnel provided comments on the timing of AoAs and suggested that AoAs be conducted at each MS decision. Benefits would include an increase to the fidelity and structure of the analysis and an increase in the information flow for the analyses. Army AoA team personnel noted analyses should also be performed before MDD to identify capability gaps. These analyses may not be associated with an AoA.

Army AoA team personnel indicated that a purpose of an AoA was to determine the desired attributes through cost, schedule, and performance trades. The Army AoA team noted

that an alternative should represent a set of attributes, and the alternative should not be associated with a system or platform. Alternatives are vessels to hold attributes together to better understand the interdependencies of attributes.

A concern was raised regarding the number of alternatives considered in an AoA. The Army AoA team recommended including six or fewer alternatives in an AoA to be able to complete the analysis in a 9- to 12-month time frame. The Army AoA team noted that alternatives should be eliminated if they are infeasible, and there should be a limited number of "special interest" and foreign systems. Special interest systems denote systems that are required to be included in analyses from Army or OSD senior leaders. The Army AoA team also noted that alternatives should be eliminated by the SAG if the alternative are no longer feasible or do not add information to the decision choices. Also, analyses that do not add information relevant to the decision should be stopped.

Army AoA team personnel were very concerned about obtaining detailed data for foreign systems. The Army AoA team noted that to perform the same type analysis on foreign systems as U.S. systems, detailed design, performance, and cost data would be required. If these data cannot be obtained, there would be greater uncertainty in the results. The AoA team also raised an issue that all foreign systems would require modifications, and the cost and risk of these modifications should be included in the analyses. Finally, Army AoA personnel said that the United States rarely buys foreign systems, and that foreign systems should not be considered if they are not viable, feasible candidates.

Army AoA team personnel stated that AoAs should consider and focus on other analyses besides effectiveness. These other areas would be related to alternatives impact to sustainment, force structure, transportability, and DOTMLPF.

Tradeoff analyses for cost, schedule, and performance were noted as important analyses in AoAs. Army AoA team personnel noted that WSARA required the analyses, and the analyses should be performed across and within alternatives. The trades should be conducted at the system and subsystem levels. The AoA team said the trade space must be fully explored, and the trades should continue throughout the AoA. Army AoA team personnel stated that an AoA should identify the most affordable, cost-effective solution through the tradeoff and cost-benefit analyses.

Risk analysis was also noted as an important analysis in an AoA. Army AoA team personnel noted that risk analyses are closely related to the tradeoff analyses. The AoA team recommended that risk assessments should be conducted for cost, schedule, and technical rather than cost, schedule, and performance. Army AoA team personnel stated that a coherent, robust risk and trade methodology must be developed by the Army.

Because WSARA increased the scope and complexity of AoAs, the Army AoA team personnel thought there was a significant increase in analytical work to address WSARA AoA requirements. This additional workload requires additional analysts (cost and performance) and funding to support conducting AoAs. There are resource challenges associated with the conduct of AoAs.

Army AoA team personnel suggested that O&S and LCC be used in AoAs—specifically for the tradeoff analyses. It also was noted that cost methodology should be refined to develop more estimating relationships that link performance to cost, incorporate risk better, and consider affordability.

Discussion of Army AoA Oversight Organizations Interview Results

One of the main points of the Army AoA oversight personnel was that AoAs should support the requirements development process and indicated that WSARA gave OSD CAPE more influence on AoAs, because OSD CAPE has to declare an AoA sufficient (which is linked to AoA certification) to support MS decisions. The AoA oversight personnel mentioned that OSD CAPE is more focused on supporting the MS decisions. Army AoA oversight personnel stressed that AoAs must satisfy all the customers including OSD CAPE, the acquisition community, the requirements community, and the portfolio mix community.

Army AoA oversight personnel said AoAs must address the decision process and OSD CAPE's decision choices, and noted OSD CAPE's decision choices are more strategically focused. AoA oversight personnel also recommended that AoAs not address issues already being addressed in the acquisition process (e.g., source selection, acquisition strategy, designing the system).

Another point from the Army AoA oversight personnel was that analyses should be conducted before the MDD. These analyses would entail the identification of capability gaps, threats, problems, attribute trade space, and feasible alternatives. The AoA oversight personnel also noted that capability gaps and CONOPS should be developed before the start of an AoA.

Army AoA oversight personnel stressed that the purpose of an AoA is to develop the supporting evidence to identify an achievable, affordable, and operationally relevant set of attributes. The AoA oversight personnel believe that alternatives are used to represent a set of attributes, which would be used in developing the CDD.

Some of the Army AoA oversight personnel also noted that timing of AoAs is not well coordinated with the requirements development process or to support the PMs. They stated that an AoA for MS A is too early, because not enough information is available to make the cost, schedule, and performance trades. MS B is too late, because the CDD must be finalized before then. These AoA oversight personnel recommended the correct timing for an AoA is at the PDR. In addition to the MS A or PDR AoA, the Army AoA oversight personnel noted that AoAs, or AoA updates, are needed to support all decision points throughout the acquisition process.

Because Army AoA oversight personnel believed that foreign systems may not be purchased by the United States, the oversight personnel thought that foreign systems should only be considered in AoAs for comparison purposes to investigate capabilities and attributes. The AoA oversight personnel also noted that foreign systems would have to be modified to meet U.S. standards.

The Army AoA oversight personnel stressed the importance of tradeoff analyses for cost, schedule, and performance and said the trades should be performed within and among alternatives to address the decision space. The oversight personnel noted that risk assessments should also be made on the given cost, schedule, and performance, or the traded values. Also related to the tradeoff analyses, the Army AoA personnel noted that the importance of reducing system costs for affordability reasons.

Because of the increased workloads of the analytical community from post-WSARA AoAs, the Army AoA oversight personnel thought there would be a shortfall of resources (funding or personnel). They thought a central funding source should be available for AoAs, and they noted the need for more skilled analysts for technical risk assessment, cost analyses, and affordability assessments.

The Army AoA oversight personnel recommended that the Army be more candid and open with OSD CAPE and thought the Army should work closer with OSD CAPE earlier in the AoA processes to understand guidance and, obtain agreement on the alternatives and foreign systems.

Discussion of OSD CAPE Interview Results

OSD CAPE personnel are focused on supporting acquisition MS decisions. WSARA requires an AoA to be performed before a MS decision in accordance with OSD CAPE guidance. OSD CAPE personnel noted that their level of responsibility for an AoA increased due to WSARA. OSD CAPE develops the AoA guidance and determines if the AoA was performed consistently with the guidance. OSD CAPE noted that WSARA also has increased the importance and interest in AoAs.

A common theme throughout OSD CAPE's responses was their desire for the AoAs to be objective, transparent, and open. OSD CAPE personnel don't want the Army to have a preferred alternative at the beginning of an AoA and for the Army to gear the analyses toward that solution. They would like an objective analysis that supports a recommended solution. OSD CAPE personnel would like the AoAs to consider the positive and negative aspects of each option. OSD CAPE personnel also want a better understanding of the analyses and assumptions and would like the Army to be more transparent with their assumptions and analyses.

It is OSD CAPE's position that an AoA is required at MS A, and there is one set of guidance good for all MS decisions. The AoA guidance supplies questions to be answered, and OSD CAPE noted that the AoA team should answer the questions to its best ability with the information available. This is especially germane to a MS A AoA, where some information may not be available. OSD CAPE personnel also stressed that AoAs are not required at later MS decisions, except when they request an update. An update could be requested if assumptions change, new threats are identified, or the ACAT level changes.

OSD CAPE is interested in having a robust set of alternatives considered in the AoA, such as a broad search for alternatives including a detailed screening analysis. OSD CAPE personnel would like the alternatives to cover the decision space, and they are also interested in changing "lesser" alternatives to determine if they could be made more competitive.

OSD CAPE personnel strongly supported having foreign systems in the AoA. They realized the foreign system might not be purchased, but they did not think that was a reason not to consider them. OSD CAPE personnel noted that the decision actually to purchase a foreign alternative does not fall to OSD CAPE nor the AoA team. They would like the Army to do its best to obtain data and information on the foreign systems. OSD CAPE suggested another

purpose of considering foreign alternatives is to learn more about their features, attributes, technical feasibility, and cost.

OSD CAPE personnel stressed that analysis should be quantitative instead of qualitative judgment-based. They do not like the SME-based value assessments, but rather have analyses based on engineering models or real-world test results. OSD CAPE personnel noted that the analyses should be focused on the decision choices, and there is no point in performing analyses that do not support the decision choices.

OSD CAPE personnel would like the AoA to explore the trade space in detail. They require cost, schedule, and performance trades to be performed in the AoAs and noted that sensitivity analyses should be conducted along with the tradeoff analyses, and the bounds for the sensitivity analyses should be expanded.

Another theme throughout the OSD CAPE interviews was OSD CAPE wanted to see affordable and cost-effective alternatives; OSD CAPE desired cost-effectiveness analyses, operational effectiveness to cost graphs, and performance vs. cost graphs.

Comparison of Interview Results

A number of similarities and a few differences existed between the three groups of interview results. All groups agreed that WSARA has increased OSD CAPE influence in AoAs, and that OSD CAPE is focused on supporting the MS decisions. The Army personnel, especially the Army AoA oversight group, wanted the AoA process to increase their support to the requirements development and acquisition communities.

Both Army and OSD CAPE personnel desired more communication between OSD CAPE and the Army analysis community, and this communication should start earlier and continue throughout the AoA. All groups agreed that the Army should be more candid, open, and transparent with OSD CAPE. Another important point was the objectivity of the analysis and presenting results. Army and OSD CAPE that there should not be a preferred alternative, and the analyses should be unbiased. Finally, there was agreement that the analyses and assumptions must be understandable to OSD CAPE, which could be realized through a closer working relationship.

Army personnel stressed the importance of providing information to the decision-makers and addressing OSD CAPE's decision choices. The Army noted that OSD CAPE's decision choices may not be related to only the alternatives, but to investment, acquisition, and

strategic/fleet options. OSD CAPE personnel stated that they also wanted other questions answered in addition to the comparison of alternatives. OSD CAPE personnel noted that the analyses should be focused on the decision choices, and analyses should not be performed unless they support the decision choices. Army AoA team personnel said decision choices may focus on other issues besides effectiveness, such as sustainment, force structure, transportability, and DOTMLPF.

There were different thoughts on the number and timing of AoAs by Army and OSD CAPE personnel. OSD CAPE's position is that one AoA is required (usually at MS A), and AoAs are not required at later MS decisions unless an update is requested. The Army AoA team personnel stressed that AoAs are needed at each MS decision. The AoA team thought that without a formal AoA, the fidelity and structure of the analyses would suffer, and it would be more difficult to obtain the needed information to perform analyses without formal AoAs. Both Army AoA oversight and team personnel recommended that analyses should be performed before MDD to identify capability gaps, potential issues, and potential feasible solutions. These pre-MDD analyses are necessarily part of an AoA. Some Army AoA oversight personnel also wanted to change the timing of AoAs to better support the requirements development process and the PMs. They suggested a better timing for an AoA is at PDR.

Army personnel stressed the importance of identifying a required set of attributes for a system in the AoA process, especially for the MS A AoA. They said the AoA should develop the supporting evidence to identify an achievable, affordable, and operationally relevant set of attributes. To follow that objective, they noted that an alternative should represent a set of attributes rather than be associated with a system or platform. The Army personnel said these attributes would be used to help develop the CDD. OSD CAPE mentioned that the AoA should help inform requirements, but did not discuss attributes in detail.

The Army AoA team raised the concern about having too many alternatives in an AoA and recommended having six or fewer alternatives. They also wanted alternatives eliminated by the SAG if they were no longer feasible or add nothing to the decision choices. OSD CAPE, on the other hand, wanted a robust set of alternatives in the AoA. They wanted a broad search in the beginning and the range of alternatives to cover the decision space.

The views of foreign alternatives differed between the Army and OSD CAPE. OSD CAPE personnel strongly supported included foreign alternatives in the AoAs. Army AoA team

personnel were concerned about obtaining data for foreign systems and performing equivalent analysis between foreign and U.S. alternatives. OSD CAPE personnel said the Army AoA team should do its best to obtain data on the foreign systems. Army and OSD CAPE personnel agreed that the foreign alternative may not be selected, because of political reasons. OSD CAPE personnel thought purchasing a foreign system was not their decision, and that foreign systems still should be considered. Army personnel recommended not including foreign systems that are not viable, feasible candidates. Army AoA oversight personnel thought foreign systems should only be considered in AoAs for comparison purposes to investigate capabilities and attributes. Both Army and OSD CAPE personnel noted that modifications would have to be made to foreign systems, and the cost and schedule of these modifications should be included in the AoA.

There was agreement between the Army and OSD CAPE on tradeoff analyses. Both the Army and OSD CAPE stressed the importance of tradeoff analyses for cost, schedule, and performance. All groups said trades should be performed within and among alternatives to address the decision space and explore the trade space. Army and OSD CAPE personnel agreed that the AoA should identify affordable, cost-effective solutions. Army personnel noted the importance of risk analyses in the AoA. OSD CAPE did not stress the importance of risk analyses. However, they did recommend risk analyses in their publications.

Army personnel from the AoA team and AoA oversight organizations discussed the increase in analytical work because of WSARA. The Army noted challenges associated with resources, and recommended that a central funding site be available to conduct AoAs. The Army personnel also identified the need for more skilled analysts in the technical risk assessment, cost analyses, and affordability areas.

Recommendations

The following are key recommendations based on the interview answers and literature search results. These recommendations are to better meet OSD CAPE expectations, meet other AoA customer expectations, and improve the value of AoAs. Appendix D provides additional recommendations.

The Army AoA community and OSD CAPE should build a closer working relationship. In the past, the relationship between the Army and OSD CAPE was characterized by suspicion and distrust. The current relationship has improved, but both organizations should continue to build a closer working relationship built on trust. As recommended by both organizations, there should

be more communication between the Army AoA community and OSD CAPE. Both the Army and OSD CAPE must be candid, open, and transparent in their interactions. Trust has to be extended to build trust, and both organizations must demonstrate respect for each other (Covey, 2006). The Army needs to ensure that the analyses and results are objective and appear objective to OSD CAPE. Both organizations need to interact frequently to ensure OSD CAPE has an understanding of the assumptions and analyses. The Army AoA team and OSD CAPE personnel should discuss the analyses monthly either through meetings, video teleconferences, or teleconferences. Regular reviews at the SES level should be conducted to ensure the Army team is on track to meet OSD CAPE expectations. The benefits of a closer working relationship would be less rework because of clarified expectations, greater acceptance of the analyses by OSD CAPE, fewer OSD CAPE questions later regarding the analyses, less follow-up work, and more focused analytical products.

AoAs should focus on the decision choices and the decision space. In the past, Army AoAs have focused on performing specific analyses on well-defined alternatives. The analyses tended to center on operational effectiveness and performance, and there were only a few, well-defined, obvious alternatives. WSARA, and the reduction of DoD funding, caused a change in the information decision-makers require. There is more focus on cost, affordability, and portfolio management. There is more scrutiny on starting a new program or on how many items are procured. The decision choices may be related not only to the alternatives, but to investment, acquisition, and strategic/fleet options. The decision choices may focus on other issues besides effectiveness, such as DOTMLPF, sustainment, force structure, transportability, and strategic impacts. Another important factor is the decision space (i.e., the breadth of options to consider). The trade space for cost, schedule, and performance must be fully explored to frame the decision space. Due to funding restraints, the decision space may have to be widened to weigh options not typically considered. The AoA team should work closely with OSD CAPE and Army leaders to fully understand the decision choices and the decision space. The types of analyses should be focused on the decision choices. Analysis that does not support the decision choices should not be performed. This focus could result in less operational effectiveness and performance analyses in AoAs, depending on the specific decision choices. A focus on the decision choices and decision space would increase the relevant, usable information presented to the decision-makers.

AoAs should identify an achievable, affordable, and operationally relevant set of attributes. Besides supporting the MS decisions, AoAs should also inform the requirement development process. MS A AoAs should identify specific attributes needed to fill the capability gaps, which would feed into the CDD development. AoAs should develop the supporting evidence to identify an achievable, affordable, and operationally relevant set of attributes. The alternatives should represent a set of attributes and should not be related to a certain system or platform (i.e., the alternatives should be platform agnostic). If OSD CAPE's decision choices are related to certain systems or platforms, the AoA would have to include them. Again, the AoA team must work closely with Army and OSD CAPE leaders to ensure the alternatives address the decision choices. The CDD development process would greatly benefit from the identification of an achievable, affordable, and operationally relevant set of attributes.

The focus of foreign systems should be to investigate features, capabilities, attributes, feasibility, and cost. Foreign systems will be required in AoAs through OSD CAPE guidance. Although the foreign system may not be pursued in the acquisition process, there is much to be learned from analyzing foreign systems. Foreign systems may include unique features or attributes not included in U.S. systems. By examining these features or attributes, the Army may include them in its CDD development. If a particular technology is used on a foreign system, information on the feasibility of including that technology on U.S. systems would be gained. Identifying the cost of the foreign systems would provide a cost comparison for U.S. systems. It may be easier to identify the attributes and capabilities of foreign vehicle rather than obtain the detailed design data. This focus on capabilities and attributes could reduce the data collection issues.

The Army should create a formal analytical process that supports MS decisions, requirements development, materiel acquisition, and portfolio management throughout the acquisition process. The analytical process must contain an AoA for MS A, or the first MS decision for a program, per statutory requirements. OSD CAPE provides formal guidance for this AoA. The Army can perform additional AoAs, or AoA updates, at the MS B and MS C decisions, but they may not have OSD CAPE oversight. This analytical process should start pre-MDD by supporting capability gap development, attribute trade space, alternative formulation, and issue identification. An AoA, a Business Case Analysis (BCA), or a Cost-Benefit Analysis (C-BA) can be performed to support the CDD development. These analyses can leverage the MS

A AoA and form the basis for a MS B AoA. The timing for this analysis would be for the PDR, and the tradeoff and risk analyses would be beneficial to the PMs. Army tradeoff and risk analysis would help the PM assess the contractors design at PDR. For MS B, the AoA could compare the alternatives to the requirements and to each other and help determine whether to build the system. Post-MS B, analyses could support production, fielding, distribution, and sustainment decisions. An AoA team could be established pre-MDD and continue throughout the acquisition process. The benefits of a formal analytical process include the following: increased structure of analyses; greater fidelity of analyses; increased support to the requirements development, PEO/PM, and portfolio management communities; and retention of experienced analyst for a specific system.

Limitations

Interviews were conducted for the key personnel at AMSAA, TRAC, DASA-CE, DAMO-CI, and ARCIC. If time were not constrained, it would have been beneficial to interview Army personnel from the ARL Survivability and Lethality Analysis Directorate (SLAD), the Office of the ASA(ALT), and the Office of the DCS G-8. Other organizations where it could be potentially beneficial to interview personnel are the TRADOC COEs, RDECs, PEOs, and PMs. OSD CAPE was the only organization where personnel were interviewed for OSD. Other potentially beneficial organization's personnel to interview are with the USD(AT&L) and the JS.

Implications for Future Research

Future research could expand the scope of organizations to be interviewed. As noted in the previous section, personnel from other Army and OSD organizations could be interviewed. Besides interviewing additional people, future research could focus on studying the Army, Air Force, and Navy AoAs that have been deemed successful by OSD CAPE. A broader examination of how foreign countries conduct AoA-like analyses may be beneficial. Also, a historical inspection of analyses was conducted before AoA could be the focus of future research. Future research also could be performed on the creation of a formal analytical process that supports MS decisions, requirements development, materiel acquisition, and portfolio management.

Summary and Conclusions

This report outlined the research to determine how to improve Army AoAs to better meet the requirements of the WSARA of 2009 and the expectations of OSD CAPE. A literature review was performed to provide an overview of the statutory and regulatory requirements for

AoAs, the aspects of WSARA related to AoA, Army efforts to improve AoAs, and OSD CAPE suggestions on how to improve AoAs. Results of the literature search were provided in Chapter 2. Chapter 3 reviewed the research methodology, identified the interviewees, and listed the interview questions. Key senior-level Army and OSD CAPE personnel were interviewed, and their key points presented in Appendixes A, B, and C. From the interviews, a summary of the key points was compiled and presented in Chapter 4. Chapter 5 included discussions of Army AoA team, Army AoA oversight organizations, and OSD CAPE interview results. These results of the three different groups were compared. Recommendations were developed from the interview results to improve Army AoAs. These recommendations included the following:

- The Army AoA community and OSD CAPE should build a closer working relationship.
- AoAs should focus on the decision choices and the decision space.
- AoAs should identify an achievable, affordable, and operationally relevant set of attributes.
- The focus of foreign systems should be to investigate features, capabilities, attributes, feasibility, and cost.
- The Army should create a formal analytical process that supports MS decisions, requirements development, materiel acquisition, and portfolio management throughout the acquisition process.

REFERENCES

ARCIC, TRAC, & AMSAA (2011). *Analysis of Alternatives (AoA) Review*. 2 May 2011. Unpublished manuscript.

Berteau, D.J., Hofbauer, J., & Stephanie, S. (2010). *Implementation of the Weapon Systems Acquisition Reform Act of 2009: A Progress Report.* Center for Strategic and International Studies, 1800 K Street NW, Washington, DC 20006.

Brown, B. (2009). Directive-Type Memorandum (DTM) 09-027 Implementation of the Weapon Systems Acquisition Reform Act of 2009 (Public Law 111-23). Defense Acquisition University.

Covey, S.M.R. (2005). The Speed of Trust: The One Thing That Changes Everything. New York, NY. Free Press.

Decker, F. & Chandler, R. (2011). *Analysis of Alternatives (AoA) & DoD 5000 Process Changes*. TRAC & AMSAA presentation. Unpublished manuscript.

Defense Federal Acquisition Regulation Supplement (1998), August 17, 1998

Defense Acquisition Guidebook (2011). Defense Acquisition University. Retrieved from https://dag.dau.mil.

DoDI 5000.02. (2008). *Department of Defense Instruction, Number 5000.02,* December 8, 2008, USD(AT&L). Retrieved from http://www.dtic.mil/whs/directives.

Directive-Type Memorandum (DTM) 09-027. (2009). *Implementation of the Weapon Systems Acquisition Reform Act of 2009.* Retrieved from http://www.dtic.mil/whs/directives.

DTM 10-017. (2010). Development Planning to Inform Materiel Development Decision (MDD) Reviews and Support Analyses of Alternatives (AoA)

Duke, J. & Kaspersen, K. (2011). *Analysis of Alternative: Statute, Policy and Recent Practices.* MORSS WG 2163. 21 June 2011.

Government Accountability Office (GAO) (2010), *Many Analyses of Alternatives Have Not Provided a Robust Assessment of Weapon System Options,* Report to the Chairman, Subcommittee on National Security and Foreign Affairs, Committee on Oversight and Government Reform, House of Representatives, GAO-09-665, September.

GAO (2011). Defense Acquisitions Assessments of Selected Weapon Programs? GAO-11-233SP. March.

Hume, R. (2012). Studies & Analysis Division (S&AD) Overview: Building a Strong Analytical Foundation for the Capability Development Process, ARCIC, TRADOC. Unpublished manuscript.

Husband, M. & Kaspersen, K. (2012). *The AoA: An Early Filter to Create an Affordable Program.* Manuscript submitted for publication.

Lymon, D.G., McWhorter, M., & Violette, M. (2011). *The Evolution of the Weapon System Reform Act of 2009 (Public Law 111-23).* Naval Postgraduate School, Monterey, CA.

Roper, M. (2010). *Risk Considerations in Pre-MS A Cost Analysis.* Office of the Deputy Assistant Secretary of the Army for Cost and Economics. Unpublished Manuscript.

TRAC (2011a). TRADOC Assessment AoA Guidance in DoD 5000 Series, WSARA and In Practice. Unpublished Manuscript. 2 May 2011.

TRAC (2011b). Capabilities Based Assessment (CBA) and pre-Materiel Development Decision (MDD) Process Change, 79th MORSS, 20-23 June 2011.

TRADOC (2011). TRADOC Recommended Changes to DoD AoA Guidance. Unpublished Manuscript.

U.S. Code Title 10—Armed Forces, Subtitle A—General Military Law, Part IV—Service, Supply, and Procurement, Chapter 139 Research and Development, 10 U.S.C. § 2366a—Major defense acquisition programs: certification required before MS.

U.S. Code Title 40—Public Buildings, Property, and Works.

Weapons Systems Acquisition Reform Act of 2009, Pub. L. No. 111-23, § 123 Stat. 1704 (2009).

GLOSSARY OF ACRONYMS AND TERMS

AAE	Army Acquisition Executive
ACAT	Acquisition Category
ADM	Acquisition Decision Memorandum
AMSAA	Army Materiel Systems Analysis Activity
AMUC	Average Manufacturing Unit Cost
AoA	Analysis of Alternatives
APUC	Average Procurement Unit Cost
ARL	Army Research Laboratory
ASA(ALT)	Assistant Secretary of the Army for Acquisition, Logistics, and Technology
AT&L	Acquisition, Technology and Logistics
BCA	Business Case Analysis
BOI	Basis of Issue
C4	Command, Control, Communications, and Computers
CAA	Center for Army Analysis
CAD	Computer-Aided Design
CAIG	Cost Analysis Improvement Group
CAPE	Cost Assessment and Program Evaluation
CARD	Cost Analysis Requirements Description
C-BA	Cost-Benefit Analysis
CBA	Capabilities Assessment
CBRN	Chemical, Biological, Radiological, and Nuclear
CDD	Capability Development Document
CDID	Capabilities, Development and Integration Directorate
COE	Center of Excellence
COEA	Cost and Operational Effectiveness Analysis
COL	Colonel
CONOPS	Concept of Operations
COTS	Commercial-Off-The-Shelf
CTE	Critical Technology Elements
DAB	Defense Acquisition Board

DAE	Defense Acquisition Executive
DAG	Defense Acquisition Guidebook
DAMO-CI	Department of the Army, Military Operations - Capabilities Integration
DASA-CE	Deputy Assistant Secretary of the Army for Cost and Economics
DCAPE	Director, Cost Assessment and Program Evaluation
DCS	Deputy Chief of Staff
DDR&E	Director, Defense Research and Engineering
DFAR	Defense Federal Acquisition Regulation
DFARS	Defense Federal Acquisition Regulation Supplement
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities
DPA&E	Director, Program Analysis & Evaluation
DTM	Directive-Type Memorandum
DUSA-OR	Deputy Under Secretary of the Army (Operations Research)
FLVN	Fort Leavenworth
GAO	Government Accountability Office (formerly known as the General Accounting Office)
GFE	Government-Furnished Equipment
GS	General Schedule
HQDA	Headquarters Department of the Army
ICD	Initial Capabilities Document
ICDT	Integrated Capabilities Development Team
ICE	Independent Cost Estimate
IPR	In-Progress Review
JCIDS	Joint Capabilities Integration and Development System
JIAT	Joint Integrated Analysis Tool
JROC	Joint Requirements Oversight Council
JS	Joint Staff

JUONS	Joint Urgent Operational Needs Statement
KPP	Key Performance Parameter
KSA	Key System Attribute
LCC	Life Cycle Cost
MAIS	Major Automated Information Systems
MDA	Materiel Decision Authority
MDAP	Major Defense Acquisition Programs
MDD	Materiel Development Decision
MS	Milestone
MSA	Materiel Solutions Analysis
O&S	Operations and Support
OSD	Office of Secretary of Defense
OTS	Off the Shelf
PDR	Preliminary Design Review
PEO	Program Executive Officer
PIP	Product Improvement Program
PM	Program Manager
POM	Program Objective Memoranda
RDEC	Research, Development, and Engineering Center
RDECOM	Research, Development, and Engineering Command
RFP	Request for Proposal
SAG	Senior Advisory Group
SES	Senior Executive Service
SLAD	Survivability and Lethality Analysis Directorate
SME	Subject Matter Expert
SSA	Source Selection Authority
ST&E	Science, Technology and Engineering
SWAP	Size, Weight, And Power
TAA	
TD	Technology Development
TRAC	TRADOC Analysis Center

TRADOC	Training and Doctrine Command
TRL	Technology Readiness Level
U.S.	United States
U.S.C.	United States Code
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology and Logistics
WSARA	Weapon Systems Acquisition Reform Act of 2009
WSMR	White Sands Missile Range

APPENDIX A
ARMY AOA TEAM INTERVIEW RESULTS

This section provides the answers for the interviewees from AMSAA, TRAC, and DASA-CE, including the following:

W. Crain, personal communication, January 17, 2012;

M. Bauman, personal communication, April 3, 2012;

P. O'Neill, personal communication, January 20, 2012;

P. Blechinger & B. Pippin, personal communication, March 9, 2012;

G. Lambert, personal communication, March 14, 2012;

S. Barth, D. Henningsen, & M. Anvari, personal communication, March 19, 2012;

D. Hersh, personal communication, March 16, 2012;

R. Chandler, personal communication, January 20, 2012;

F. Decker, personal communication, February 8, 2012;

R. Eaton, personal communication, March 16, 2012;

S. Schoeb, personal communication, March 5, 2012;

A. Dinsmore, personal communication, December 27, 2011; and

S. Vessey & A. Tichenor, personal communication, March 30, 2012.

These organizations perform analyses for AoAs and form the core AoA team. The answers are compiled for each question. For each question, the interviewees' answers are grouped by general ideas. A summary of the key points for all interviewees are provided followed by the interviewees' specific comments as bullet points. The number of bullet points may not align to the number of people interviewed, because some interviewees may have provided multiple comments, or no comments, related to the summarized point. Names are not associated with specific comments to ensure nonattribution.

1. Briefly explain in your own words the purpose of an AoA.

The purpose of AoAs is to frame the decision space and to identify the best investment strategy and acquisition option. There is no best alternative, but rather a best acquisition decision.

- The purpose of an AoA is to frame the decision space associated with a major acquisition decision.

- In the past, before WSARA, AoAs compared alternatives to determine the best alternative. For current AoAs, the purpose is to frame the real decision—there is no best alternative, but rather a best acquisition decision. AoAs should look at new equipment in terms of the best investment strategy; assessment such as marginal return on investments should be included.

- AoAs provide comparison of possible options. Options can be defined as acquisition options, and the alternatives are a new start system, modified system, etc. The purpose of AoAs are not to just compare alternatives; AoAs should also define a set of pluses and minuses for each alternative, inform decision-makers on the acquisition options, and identify how to fulfill needs/gaps with a materiel solution. AoAs are more than just a "buy this system" assertion.

The purpose of AoAs is to inform the decision-makers on best investment courses of action.

- The purpose of AoAs is to inform the decision-makers on different investment courses of action for meeting or resolving capability gaps. The investment strategies are tied to an amount of funding across the life cycle. AoAs should determine the best alternative at an affordable price that mitigates the force capability gap.

The purpose of an AoA is to identify the most affordable, cost-effective solution through tradeoff and C-BA.

- An AoA is a C-BA of acquisition alternatives to help decision-makers select the most appropriate alternative for production. The AoA is a modern-day Cost and Operational Effectiveness Analysis (COEA).

- The purpose of an AoA is to identify the most cost-effective solution that is affordable.

- There should be trades during the MS A AoA related to cost-effectiveness and affordability.

- The purpose of an AoA is to select the best alternative to meet requirements.

- The AoA is used to determine the most cost-effective solution to meet a given requirement or set of requirements.

The purpose of AoAs is to inform decision-makers on benefits of materiel solutions to meet capability gaps.

- The purpose of AoAs is to inform decision-makers on the benefits of bringing another system into service. AoAs assess the benefits of materiel solutions, compare performance/cost to capability gaps, compare alternatives, and provide information to either keep the baseline system or procure another alternative.

- The purpose of an AoA is the analytical treatment of operational effectiveness, risk, and cost of potential materiel solutions to fill operational gaps and determine the operational capability.

AoAs are used to determine required performance levels and desired attributes through cost, schedule, and performance trades.

- The AoA also is used to determine the appropriate levels of performance that will be required by the key performance parameters (KPPs) and key system attributes through the tradeoff analysis. The trades are within and across alternatives among cost, schedule, and performance. The trades would help determine the minimum performance requirements needed based on the available funding and schedule.

- An AoA should help determine what the requirements should be.

- At MS A, the AoA is exploring alternatives with the Initial Capabilities Document (ICD) in hand. At this point, the Army is not sure what are the requirements or the desired attributes for the materiel solution. MS A AoAs should be platform agnostic.

AoAs are comprised of cost, schedule, and performance analyses on potential materiel solutions.

- AoAs are comprised of analyses of materiel solutions to mitigate capability gaps. The analyses include cost, schedule, and performance.

- AoAs are used to estimate the performance of the alternatives. The operational capability of the alternatives should be estimated to obtain a full picture of performance.

AoAs should support the acquisition community by identifying the cost, schedule, and performance risks.

- The purpose of an AoA is to reduce the risk of cost and schedule breaches.

- An AoA should determine if industry is capable of producing the equipment and identifying the cost, schedule, and performance risks.

AoAs should be unbiased with no preferred solution, informed about the funding available, and aligned to national security, defense, and military strategies.

- The AoA should be unbiased with no preferred solution.

- AoAs must be resource-informed and be aligned to national security, defense, and military strategies. If requirements were written too long ago, they may not align with these strategies. Changes in the national strategies have analytical relevance.

Analyses should be performed before the MS A AoA to identify capability gaps. The AoA should start as soon as a materiel solution is identified.

- AoA should be done earlier (once the JCIDS process determines a materiel solution is required) and repeated later on if needed.

- There should be some efforts before the MS A AoA, including identification of gaps and development of the ICD. This will determine the emerging set of requirements. The preliminary work should explain why there is a legitimate need for a materiel solution.

- The CDD should not be written before this MS A AoA work is completed. At MS B, there is still some trade work, but not as much exploring as MS B.

2. What do you think the major issues are associated with AoAs under the new WSARA guidance?

WSARA has had a positive impact on AoAs by increasing the importance of analysis in MS decisions. Under WSARA, AoAs have to be more accurate, detailed, and unbiased. AoAs can better support the requirements development process.

- WSARA has increased the value of AoAs. In the past, the Services may have a preferred alternative, and the study may have been biased to get the desired answer.

- WSARA has been good for AoAs. WSARA has improved the MS A AoAs, which will provide input into the development of the CDD.

- WSARA has forced everyone to be more accurate in their AoAs.

- There is also healthy friction caused by WSARA. The JS has a role with developing the Source Selection Authority (SSA) and also owns the Joint Urgent Operational Needs Statement (JUONS) process. Since the JUONS is an urgent need, the JS wants to start "bending metal" as soon as possible. OSD CAPE will ask where is the analysis to back up this decision to start development.

- Another issue involves the growing pains associated with performing more detailed AoAs with increased congressional oversight.

WSARA has increased OSD CAPE's influence in the AoA process. OSD CAPE provides the AoA guidance to the Services and determines if the AoA has been completed per its guidance. WSARA also requires the DAE to certify that the AoA has been completed in accordance with the OSD CAPE guidance. WSARA also provided a political appointee to run OSD CAPE.

- WSARA has increased OSD CAPE's influence. OSD CAPE's influence over the years has increased and decreased, depending on administrations.

- Under WSARA, OSD CAPE garnered a lot more power in the AoA arena. AoAs are OSD CAPE's mechanism to reach down into the Services to influence acquisition decisions.

- OSD CAPE has two avenues to influence the acquisition process, including the AoA and Program Review process. The AoA process is proactive, while the Program Review process is reactive. (Since the Program Objective Memoranda (POMs) are developed by the Services, OSD CAPE is a reviewer of the program.)

- WSARA has changed the responsibilities at OSD. OSD CAPE is the lead for developing the guidance, which was the responsibility of USD(AT&L). OSD CAPE is directly responsible for AoAs. If an AoA is deficient, it is OSD CAPE's responsibility. OSD CAPE determines if the AoA sufficiently meets the guidance.

- WSARA gave OSD CAPE a political appointee.

- There also are Army tensions with the new organization (OSD CAPE). The Army is tasked to perform the AoA, but OSD CAPE is responsible for the AoA being completed per their guidance. The Army should accept OSD CAPE's new responsibilities.

- There is a lot more scrutiny from OSD CAPE. OSD CAPE questions whether an AoA is robust enough. OSD CAPE produces the guidance, but it is not specific enough. OSD CAPE tends to ask for more analysis than has been done in traditional AoAs.

- WSARA requires AoAs to be certified by OSD, which gives OSD leverage over the Services. OSD determines what must be done in the study, and issues the guidance. OSD certifies that the AoA was completed in accordance with the guidance. The

Services run the risk of the AoA not being certified if it does not follow the guidance. OSD has certified all AoAs to this point. OSD CAPE/OSD has more power after WSARA.

WSARA has also caused friction between different organizations in OSD, including USD(AT&L), OSD CAPE, Policy and the JS.

- There are many different tribes in OSD, including OSD CAPE, Policy, and USD(AT&L). There is some conflict among them.

- Perhaps an unintended outcome of WSARA has been the development of a competition between the JS that approves requirements and OSD CAPE, which does not believe requirements are firm.

- WSARA has caused friction between principal organizations in OSD including USD (AT&L), OSD CAPE, JS, and Policy. Much of this friction revolves around the SSA, which is developed by OSD CAPE, the JS, and OSD Policy. OSD Policy ultimately approves the SSA. There is unhealthy fighting where organizations cannot agree on the fundamental scenarios. The Services use scenarios directly from the SSA, but OSD CAPE does not agree with those scenarios. WSARA empowers OSD CAPE in the AoA arena. OSD CAPE may not approve of the scenarios, but it doesn't have alternate scenarios.

- There is an issue with the schedule. In some cases, the DAE has designated an X-year schedule in the ADM, while OSD CAPE wants to vary the schedule per their guidance.

- WSARA has create a tension between USD(AT&L) and OSD CAPE.

Under WSARA, tradeoff analyses for cost, schedule, and performance are required across and within alternatives. The trades are at the system and subsystem levels, and they are conducted throughout the AoA. WSARA has dictated cost, schedule, and performance trades across and within the alternatives.

- The tradeoff assessments for cost, schedule, and technology. OSD CAPE has reinforced these trades in its guidance and meetings with the Army. Cost, schedule, and technology combine to produce a level of performance. All three of these can be traded to achieve different levels of performance for threshold requirements. The question is how to dial all three of these factors to meet threshold requirements.

- WSARA requires a tradeoff analysis where the cost and performance parameters are varied to determine the resulting program. Schedule also is to be considered. There is a desire from OSD CAPE to address everything at once. For the tradeoff analysis, one variable is held dependent, while the other two are the independent variable.

- WSARA increased the usefulness of the AoA by requiring more trades—both at the system and subsystem levels. In the past, cost and schedule would be considered at the end of an AoA. These cost estimates would be made on well-defined alternatives. Under WSARA, the performance may be traded for cost and schedule. This would require the initial cost analysis to be completed upfront, and unaffordable systems would be identified earlier. Both the cost analysis and operational/effectiveness analysis would be iterative processes. Ideally, unaffordable systems would no longer be initiated only to get killed in future years. By requiring more trades, the AoA now is more time-consuming and resource-intensive than in the past.

WSARA requires technical/performance, cost, and schedule risk analyses. The risk analysis is associated with the cost, schedule, and performance tradeoff analyses.

- WSARA requires risk analysis (technical, cost, and schedule risk), which is new. Tradeoff analysis is mixed into the performance risk. Performance risk can be thought of as the probability that the performance of an alternative meets the requirements. Performance vs. cost can be examined. The technical risk includes integration risk and manufacturing risk.

- WSARA specifies analysis of trades across cost, schedule, and performance to reduce risk—these trades are a new area for AoAs. The key to reducing these risks is to understand the relationships between cost, schedule, and performance. For example, to reduce high schedule risk, the performance requirement could be relaxed. Reducing the performance requirement may lessen the need for less mature technology, and more mature technology may be used. Programs have to reduce the risk across the three areas.

- WSARA has started the Army (led by AMSAA) to develop robust risk assessment methodology.

- WSARA has increased the emphasis on cost, schedule, and performance risk and the trades to mitigate those risks.

- WSARA also requires risk analysis. Both the DAE and OSD CAPE guidance require risk analysis, which has not been standardized. For TRL assessment, there is no joint or defense standard. No one has quantified manufacturing and integration risk. There may be a difference in a OSD CAPE view of schedule or TRL rating than the DAE view.

- WSARA also mandates that cost, schedule, and performance risk be assessed. Before WSARA, the emphasis was on performance risk. After WSARA, the risks should be more integrated, which is an improvement on focusing just on performance risk.

WSARA has increased the emphasis on cost and schedule analyses in AoAs.

- The focus has shifted to cost and schedule for AoAs. There is less emphasis on performance. The challenge is to bring cost and schedule analyses up to the level of the performance analyses.

- Cost analyses also can be more independent.

- WSARA increased the emphasis of cost earlier in the acquisition process. Before WSARA, detailed cost analyses were performed for MS B. WSARA requires detailed cost estimates for MS A. To estimate costs for MS A, the alternatives need to be defined earlier. The analytical rigor associated with MS A cost estimates has increased. The data and framework are not available at MS A to do LCC estimates.

- With the AoA considering schedule, there is more independent control over the schedule analysis. For ongoing AoAs, the Army is considering options for the schedule— although the PMs don't want to provide more than one schedule.

Under WSARA, the scope of AoAs has increased. Cost, schedule, and performance must be estimated, traded, and assessed for risk. The tradeoff analyses and OSD CAPE guidance have increased the number of alternatives.

- AoAs under WSARA have created the desire to look at everything, including cost, schedule, and performance. The OSD CAPE guidance varies for each of those analyses.

- The OSD CAPE guidance includes many different factors, and, under WSARA, the Army has to follow the guidance. The guidance may dictate a MS B-like AoA to be completed for MS A, or a MS A-like AoA for a MS B if OSD CAPE wants to fix the MS A AoA. This changes a linear AoA process into a circular one.

- The Study Plans seem to evolve over time vs. getting finalized early in the process. Additional alternatives are often added in the middle of the study. With the cost, schedule, and performance trades, the system's requirements will be evolving throughout the AoA. These changes in requirements may produce additional alternatives later on in the AoA. Additional analysis would have to be performed on these new alternatives.

- A problem is the OSD CAPE AoA guidance is not sufficient, which may indicate there is no common understanding about AoAs. The instructions in the guidance are open to interpretation.

Because of the increased complexity and interest in AoA from WSARA, the Army has experienced an increased workload in the analytical community. This increased workload requires additional analysts (cost and performance) and funding to support conducting AoAs.

- WSARA has increased the workload to perform AoAs. There is greater interest in AoAs. Because of this increased workload, the analysis community is not resourced to perform AoAs. Funding previously used to fund AoA has been reduced or eliminated.

- AoAs are not a lot more complex, whether it makes sense to add this complexity or not. OSD CAPE is more broadly focused. Sometimes the OSD CAPE guidance contains "red herring" questions.

- WSARA has tripled the analytical workload, but the "bang for the buck" may not be totally there.

- The Number One issue is resources. The cost analysis community did not increase personnel levels required to accomplish the additional analysis required by WSARA. Before WSARA, only a few (four) alternatives would require cost estimates. After WSARA, many more cost estimates are required. There may be 20 alternatives considered in the early screening process, which may require some level of cost estimates. After the screening analysis, the number of alternatives may drop to six or eight. These alternatives would require a more detailed cost estimate. WSARA has increased the trades for cost, schedule, and performance for the subsystems within alternatives. Cost estimates would be required for any of these trades. With the

additional screening, number of alternatives, and subsystem trades, there is an increase in the required cost analyses.

- A number of studies have concluded that additional cost analysts were required in DoD. The Army sponsored a study that resulted in a recommendation to add 30 additional cost analysts at TRADOC in the ARCIC and in the COEs. The Secretary of the Army commissioned a study of the Army's acquisition system by an independent panel. The resulting report, "Army Strong: Equipped, Trained and Ready Final Report of the 2010 Army Acquisition Review" had similar conclusions. In response to a congressional staff member request concerning the shortage of cost analysts, pricing analysts, and contract specialists, USD(AT&L) sent out a data call. They requested an additional 160 cost analysts throughout the Army. Some of the analysts were for DASA-CE and TRADOC WSMR to perform the additional AoA required by WSARA.

- The time required to complete the AoA has increased due to the evolving Study Plan and the extensive focus on trades.

3. How do you think AoAs should be tailored for different MSs?

AoAs should be tailored specific to the program, the decision space, and the different MS decisions.

- AoAs should be tailored for different MS, and how they are tailored depends on the specifics to the program.

- There are similar analyses at the MSs. The exact types of analyses depend on the solution set (i.e., the types of alternatives drive the analyses).

- The AoAs should be tailored for each MS.

- No two AoAs are alike.

- There are no cookie-cutter solutions for AoAs in MS A or MS B. AoAs have to be tailored to the decision space. The framing of an AoA will depend on the decision space.

More information and data are available for the later MS AoAs as opposed to the MS A AoAs. The resolution of the alternatives is greater, and there is more knowledge of the performance.

- The Defense Acquisition Boards (DABs) have different information available at the different MSs with greater resolution of the alternatives and analysis from MS A, MS B through MS C.

- At the different MSs, there is a different playing field for the alternatives. There is much more knowledge of performance at the later MSs. The caveats and limitations of the alternatives must be noted. If data are available for an alternative, the best representation of that alternative can be made. The paper system with surrogated data typically does better than actual systems.

- The level of detail needed at MDD, MS A, MS B, and MS C is different. There are fewer details available at MS A. At MS B, the cost estimates are refined, and the alternatives are defined in more detail.

- The knowledge base is much different at MS A vs. MS B. At MS B, it is much more mature. The Army has to build knowledge earlier and often using the "big tent" idea—bringing in PMs, RDECs, users, etc.

- The level of knowledge available is different between MS A and MS B. There is much more knowledge at MS B, and metal may have already been bent. Knowledge relates to data and information used in the performance analysis. At MS B, the Computer-Aided Design (CAD) data are better.

- The alternatives will be better defined at later MSs, and the work breakdown structure has more detail.

As a system progresses through MS A, MS B, and MS C decisions, the program (i.e., budgets and timelines) become more concrete and constrained. There are more tradeoffs between cost, schedule, and performance at MS A.

- Also, as a system goes from MS A, MS B, and MS C, the program becomes more concrete and constrained. The budgets and timelines become more constrained throughout the development cycle. More tradeoffs are available for MS A than MS B and MS C. For the tradeoff analysis at MS A, all three factors can be traded (cost, schedule, and technology). For MS B, the emphasis of the trades is more in the technology arena.

- Early on (at MS A) there are more assumptions, and it is more difficult to play alternatives in combat models.

- AoA are tailored based on MS, however, both the level of analysis and effort seem to be less for each MS. For the AoA, the amount of work is probably much greater for the MS A vs. a MS C. This difference in work would be attributed to the trades within the alternatives in MS A.

There are more alternatives and courses of action at MS A than MS B. MS A AoA should consider a wide range of technologies and systems.

- There are more alternatives early on.

- The scope of alternatives and courses of action are broader at MS A than MS B.

- The number of candidates/alternatives should be getting smaller as the program progresses through the MSs.

- For MS A, the AoA should bracket the types of systems and technology that ought to be considered.

- MS A AoAs should develop the needed initial capability. To do this, the AoA should determine if there is a gap and how to address the gap. A breadth of technologies should be assessed. A wide aperture of new systems should be considered. More candidate systems or technologies need to be considered and then screened down through the AoA.

The detail, fidelity, and robustness of analyses in AoAs increase from MS A to MS B and MS C. More detailed scenarios are used as the program progresses.

- More detailed analysis should be conducted as the program progresses through the MSs. The fidelity of the analysis also should increase.

- This increase of data and information from MS A to MS B provides a higher fidelity of analysis; all analysis is better at MS B.

- The cost estimates are more robust at the later MSs, but the estimation method is the same.

- For most cost analysis products, a more detailed estimate is developed the system progress from supporting a MS A to MS B to MS C. The tools and approaches are different for developing cost estimates for these different MSs. At MS B and MS C, the alternatives would be better defined and a more detailed analysis would be performed. The quality and fidelity of the cost estimates improve as a system progresses through MS B and MS C.

- More detailed scenarios should be used as the program progresses. There should be fewer scenarios considered at MS A, and more scenarios added as the program progresses.

At MS A, the AoA should include a thorough tradeoff analysis of cost, schedule, and performance. The MS A AoA should model a set of attributes as an alternative, and the alternative should not be associated with a system. At MS A, alternatives can serve as vessels to hold the attributes together to better understand the interdependencies of attributes. Performance and cost estimates will have to be made quickly for the evolving alternatives. First-order estimates of performance and cost will have to be made.

- At MS A, there should be a very thorough cost-informed trades effort and risk assessment. The MS A AoA should model a set of attributes and should be platform agnostic. Trades have to be made on the attributes within the Army, or including industry. Cost-informed trades should be conducted to determine target concept design. Risks should be assessed for cost, schedule, and technology. Trades should be performed to determine a mature concept design.

- For a MS A, the AoA should consider all viable alternatives and then perform some trades within each alternative.

- For the concept design, the Army needs first-order estimates, not estimates to six significant figures. There is no way to create a concept design out of general requirements at this point (MS A AoA). The concept designs have to be developed rapidly without the detailed design. We can't afford to go through the SLAD detailed vulnerability analyses, for example. Complex detailed designs won't work for future AoAs. The concept designs have to be generated quickly. Performance and cost estimates will have to be made for the evolving concept designs. Because the concept design is evolving due to trades, these designs will have to be developed quickly.

- For MS A, the AoA is focused on desired attributes. These attributes are fit together into alternatives. At MS A, alternatives can serve as vessels to hold the attributes together to better understand the interdependencies of attributes. The TD phase includes a new start alternative along with other alternatives (modernization, NDI, etc.).

- For MS A, early costing tools are used to estimate costs based on capability. These tools are different than other cost estimates that are based on specific systems with known technical and performance characteristics. The early cost estimating considers historical data.

The tradeoff analyses continue at the beginning of the MS B AoA, but later in the AoA the alternatives should be solidified. The MS B AoA would compare the alternatives to the requirements and to each other. The MS B AoA should consider broader acquisition options to fulfill the needs.

- Work should continue on the trades early in the MS B AoA process. Industry should provide input on what can be done. At this point, industry is trying to build/design to a system, and this work should be leveraged. The alternatives should not be locked down early in the MS B process. At a certain point, the alternatives are solidified. At this point, the MS B AoA would resemble a classic AoA (i.e., the AoA would compare the alternatives to the requirement and to each other).

- MS B is the big decision—do we invest in a new program? As such, the aperture should be opened more to better understand the possible options to fulfill the needs. The AoA should talk broader acquisition options for MS B.

- MS B AoAs should finalize the needed capability. There should be a reduced set of alternatives for this AoA. The AoA should ask how else can we meet the needed capability and what resources are available. Options may include buying off the shelf or new start program. At the MS B AoA, the candidates are to meet the capability gap, and they should be compared to the requirements. Cost-effectiveness is a significant part of MS B. Cost and operational effectiveness drivers should be identified.

- For MS B, there is a specific set of alternatives to assess. The AoA should determine if the new start alternative is better than the baseline alternative. The other alternatives also should be compared to the baseline.

- For MS B the alternative may have been decided and the analysis would focus on refining the KPPs/Key System Attributes (KSAs) based on technical feasibility, changing requirements or cost. For MS C, again the AOA would focus on analysis around a given alternative and further refine the cost/performance trades. For MS B

and MS C, new alternatives would get introduced only if they are off the shelf and could compete on a (cost/schedule/performance) basis with the current base case alternative.

- At MS B, there are different choices, because the Army is closer to spending the big dollars.
- It is hoped that the Service is smarter going into MS B.

Although WSARA does not require a new AoA for each MS decision, conducting AoAs for each MS decision would be beneficial. Having formal AoAs at the later MSs would increase the fidelity and structure of the analysis and would increase the information flow for the analyses.

- The idea of just one AoA for an entire program is not good.
- AoAs should be conducted at each MS (A, B, C and for full rate production). The AoAs can also have updates. There should not be more than one AoA per year for a program. This approach would keep the analytical fires burning. If there is not an AoA at the later MSs, the analysis is ad hoc and has less fidelity. Also, oversight is lacking without a formal AoA. Getting information to perform the analysis outside of a formal AoA won't be as easy. AoAs provide a forcing function to get information to flow.
- To date, OSD CAPE produces a boilerplate set of guidance that is applicable to either MS A or MS B. The guidance needs to be sufficient to address the questions/issues with a focus on tipping point issues.
- WSARA doesn't require a new AoA for each MS.
- Many things change throughout the development of a system that would require that the AoAs be revisited. Significant changes in the cost, schedule, or technology would constitute a need for another AoA. Currently, there is no policy in place to kill a system once an ADM is signed.
- AoA should be done earlier (once the JCIDS process determines a materiel solution is required) and repeated later on if needed. The later AoAs would have more details.

It would be beneficial to obtain input from industry for MS A.

- Usually, there is no input from industry for MS A AoAs. There is a potential of contracting with industry to obtain information, but we may not want to do that. How

much useful information would we obtain from industry if it were not under contract? There should be more industry involvement.

AoA analysts must have a better understanding of their customers, stakeholders, and external operating environment.

- The analysts conducting the AoA must have a better understanding of the external/operating environment. They must understand the stakeholders, including OSD leaders, Army leaders, industry, and political. They must be able to make the tough decisions.

- For a recent AoA briefing to OSD and Army leadership, only three slides were reviewed by these senior leaders. These three slides listed the performance and the cost for that performance. The senior leaders were interested in making trades rather than the details of the performance.

4. What types of analysis do you think need to be performed in AoAs to meet OSD CAPE expectations?

Tradeoff analyses between cost, schedule, and technology/performance should be performed throughout the AoA. The trade space must be fully explored.

- Tradeoff analyses between cost, schedule, and technical are performed to determine the effect on performance. This includes performance at the system level and at the force level. Trades should be conducted through the study. Both MS A and MS B do these trades.

- The analysis must fully explore the trade space. The items open for trades should be identified.

- Cost-informed trades should be part of the AoAs

- Trades and growth analysis should be considered. The Army needs to make sure requirements align with gaps. The trade space is large.

- OSD CAPE now expects cost trades within alternatives and alternatives that will be affordable (alternative constrained by a cost target). The trades allow OSD CAPE to determine whether a given solution may be good enough vs. a solution that meets or exceeds every requirement. The trades also provide OSD CAPE an analytical basis to question the underlying requirements.

Risk assessments should be conducted for cost, schedule, and technical.

- Risk assessment should be conducted for cost, schedule, and technical (including integration). Risk analyses are done at MS A and MS B, but in more detail for MS A.

AoAs must address cost vs. benefits, and cost vs. performance/effectiveness.

- Cost and benefits need to be analyzed during an AoA. There is no comprehensive analysis to address cost vs. benefits. AoAs tend to be focused on the effectiveness of the systems for the benefits.

- OSD CAPE would like to have charts that show the relationship between the cost and the outcomes of the operational (force-on-force) models. These charts would show a comparison of the performance/effectiveness vs. cost. OSD CAPE also is interested in cost of subsystems vs. the output of operational models with these included subsystems. OSD CAPE is interested in the cost-effectiveness of these subsystems, which form the basis for the subsystem trades. In the past, the analysis was concentrated on the system and how the system performed.

AoAs should consider O&S cost and LCC in addition to the unit costs.

- AoAs also tend to focus on the unit cost of the systems. COEAs in the past have addressed the other areas besides effectiveness and unit cost more thoroughly than the current AoAs.

- New start systems are never cheaper to maintain. The LCC and O&S costs need to be considered.

AoAs should consider other aspects besides effectiveness, such as the following: reliability, DOTMLPF, strategic impacts, transportability, maintainability, manpower analyses, force structure impacts, and squad size impacts.

- Some aspects may be more important than effectiveness—such as reliability, DOTMLPF, strategic impacts, transportability, maintainability, manpower analyses, force structure impacts, and squad size impacts.

AoAs should include the following types of analyses: mission effectiveness, performance, cost, affordability, tradeoff (cost, schedule, performance/technology), sensitivity/parametric, risk (cost, schedule, and technical), growth assessment, sustainment, fuel consumption, energy consumption, DOTMLPF, fleet strategy, and portfolio.

- The types of analyses include the following: performance, mission effectiveness, cost, risk assessment (technical, schedule and cost), growth assessment, sustainment and

others on a case-by-case basis. The growth assessment is needed, because of the current cost environment.

- Analysis should consider the fuel aspect (i.e., electrical power, fuel or energy consumption).

- Typical analyses performed in AoAs include mobility, power and energy, performance, operational effectiveness, cost, schedule, and performance risk analysis, and trades, etc. Cost is especially important at MS B.

- The AoA must assess the performance characteristics of the alternatives and their impact on performance and operational effectiveness.

- For MS A, there are similar analyses, but affordability and cost analysis are not stressed as much.

- For MS B, the AoA needs to include performance, operational effectiveness, logistics, sustainment, LCC, and affordability analyses. DOTMLPF analysis also should be performed to help decision-makers understand the implications of pursuing a particular alternative.

- Cost-effectiveness analysis should be performed and goals prioritized. Cost reduction should be examined.

- Fleet strategy analysis should be conducted. For example, one third of the fleet would be given the best new start system and two-thirds of the fleet would be provided a modernization system.

- Parametric analysis is important, especially for MS A. This analysis will help determine the interrelationship between performance/operational effectiveness metrics (e.g., lethality, survivability, and force protection). For example, a better armor package would increase survivability and would allow the vehicle to survive longer in the battle. The vehicle would be able to engage more enemy vehicles, which would result in greater lethality. A larger weapon could engage the enemy more effectively, which would increase the vehicle's survivability. The tradeoff analysis is related to the parametric analysis.

- WSARA requires cost, schedule, and performance trades to be completed in AoAs. DoD 5000 calls out LCC estimates, operational effectiveness, and performance analysis. A DOTMLPF analysis also should be performed to identify the implications

of a particular alternative. The implications could be hidden costs for sustainment. Other items to consider are sustainment impacts, operational benefits, force structure, and DOTMLPF.

- After WSARA, the analysis has expanded to the subsystems and the portfolio of systems.

- The Capability Knowledge Base should be populated with ACAT II and ACAT III data.

- Item and system level performance analysis are key parts of the AoA. Force protection and mobility are important performance analyses. Other analyses include the following: cost, risk, trades, armor, other than armor, geospatial, C4, transportability, mobility, power and energy, Size, Weight, and Power (SWAP), reliability, Class IX, sensors, and Chemical, Biological, Radiological, and Nuclear (CBRN).

The analyses must be transparent, open, and understandable to OSD CAPE. The analyses have to address OSD CAPE's decision choices and "tipping points." Analyses have to be objective, robust, and credible.

- The analysis must be transparent and open to OSD CAPE.

- AoAs failed to speak to OSD CAPE in their language. OSD CAPE does not have the capability to do the AoAs. They are program evaluators. The Army has to learn to speak to them in ways that are relevant to their decision choices. Decision choices are not necessarily alternatives.

- The Army must be much more transparent when dealing with OSD CAPE. OSD CAPE should be invited to meetings and In-Process Reviews (IPRs). The Army has to educate them early and often. Although feeding them information early could enable OSD CAPE to use it against us, the Army has opted to bring them in on recent AoAs. The goal is to convince OSD CAPE that our analysis is unbiased and credible.

- The analyses have to be transparent to OSD CAPE—OSD CAPE has to understand the analysis and be assured that their "tipping points" are being addressed.

- The analysis must be objective and not favor one alternative, credible and robust, and tailored to the decision space.

- Past AoAs have compared the improve performance of the new start vs. base case. This analysis doesn't tell us what is good enough.

- The analysis needed in an AoA depends on must be tailored to the decision.

- OSD CAPE requires an analytically complete product regardless of whether the data can support the analysis. For example, there may not be data to perform the LCC estimates. There may not be an analogous system to estimate cost.

OSD CAPE guidance drives the types of analyses performed in AoAs, but the guidance is not consistent across AoAs.

- The key is that there is no consistent OSD expectation for AoAs. There are different AoA expectations depending on the system, and the OSD CAPE person assigned to the AoA. OSD CAPE personnel don't perform analysis, but rather check analyses that the Services produce.

- The Army should examine AoAs that OSD CAPE believes were done well, and they should learn what analysis was performed.

- OSD CAPE guidance drives what type of analysis is used in the AoA.

- Special interest questions may be asked by OSD—for example, operational energy.

5. How do you think definitions of the alternatives should be developed?

There are four basic types of alternatives to include the system in service, modifications of the system in service, NDI/foreign systems, and new start programs.

- There are basically four general types of alternatives, including the following: currently available systems (do nothing option); Product Improvement Programs (PIPs) for existing system (i.e., modernize the existing system); off the shelf (OTS) foreign or domestic systems; and new start programs.

- There are three categories of AoAs: modifications, new starts, and NDIs.

- Modernized versions of current U.S. systems should be considered, especially early on.

- A baseline alternative is required to represent what capability is available today. The other alternatives represent greater capability than what is currently available.

- Early on it is helpful to include the current system, if available, and a minimal amount of modifications to keep it operational. That would be the lower bounds on both cost and performance.

A screening analysis during the AoA would be beneficial in determining an initial set of alternatives. The screening analyses starts with a broad look for possible alternatives and reduces these alternatives based on criteria.

- In previous AoAs, screening analysis has been used to start from a larger set of potential alternatives and reduce it to an initial set of alternatives.

- Screening analysis is important to help develop and refine the definitions of alternatives. Screening analysis is necessary to remove alternatives that do not make sense and to refine alternatives definition based on criteria from COE and Army leadership. The screening analysis is led by the AoA team, but the SAG ultimately makes the decision on the AoAs. This screening analysis will help shape the decision space.

- Alternatives should be defined in a stepwise manner. At first, a wide net should be cast for possible alternatives. A focused, disciplined selection process should be undertaken to reduce the set of alternatives to a management number.

- Screening analysis can be used to define the alternatives. The criteria in the screening analysis really highlight viable alternatives. The question is what alternatives go forward in the AoA for detailed analyses.

- The AoA should start off with as broad a look as possible for alternatives. A screening process can be used to reduce the number of alternatives. For this reduced number of alternatives, a more detailed analysis will be conducted.

- The team working the study should define the alternatives with input from the stakeholders and customers. The Army stakeholders think more narrowly than the OSD customers.

- It would be beneficial to have independent organizations define the alternatives.

- The AoA team should ensure if there are a couple of requirements that are knocking out alternatives early (i.e., during a screening analysis). The team should make sure these requirements are valid.

OSD CAPE plays a significant role in the development of alternatives. OSD CAPE provides the AoA guidance and chairs the SAG which approves the alternatives. OSD CAPE should not be involved with the Services' force design.

- It would be beneficial to have agreement with the set of alternatives going into OSD.

- OSD leadership is learning what it would like to have in terms of alternatives.

- OSD CAPE should not be into force design. Force design is partly an operational art and should be left to the Services. AoAs should not jumble force design with materiel solutions or alternatives.

- The alternative definitions are developed from OSD CAPE. OSD CAPE is exposed to ideas and information that influence its identification on alternatives. OSD CAPE's horizon is broader than the Army. OSD CAPE's input is necessary as well as alternatives from the user community to address capability gaps it wants mitigated.

- The OSD CAPE guidance and the AoA Study Director should define the alternatives.

The number of alternatives should be managed to a reasonable number (six or fewer) to complete the AoA in the 9- to 12-month timeframe. Alternatives should be eliminated if they are determined to be infeasible, and there should be a limited number of "special interest" systems.

- The number of alternatives has to be reasonable, because the typical time to do an AoA is 1 year.

- The number of alternatives should be managed to a reasonable number (approximately six or fewer). Having this number of alternatives should keep the AoA duration around 9 to 12 months.

- It is difficult to cut out alternatives. The alternatives should be defined, but they keep changing throughout the AoA. OSD CAPE keeps adding alternatives. Some alternatives added are "nonstarters," but they are never eliminated. Alternatives are added, but they are never subtracted. It would be good to cut some alternatives out.

- Other organizations may add "special interest" alternatives that will continue through analysis even though they do not necessarily make sense.

- These alternatives should have a clear distinction of capabilities. There should also be a minimum allowable percentage of politically motivated alternatives (i.e., special interest cases). The loud person in the SAG should not force special interest alternatives into the AoA.

- Another question is whether special interest alternatives continue forward.

- Solutions that are not feasible will be screened out and should not be included in the AoA.

Defining alternatives is a both a top-down and bottoms-up process. The top-down process is based on guidance from Army and OSD leadership, and the bottoms-up approach is based on a screening analysis.

- The process for determining alternatives is a twofold process. A top-down process is based on guidance from Army and OSD leadership. The bottoms-up approach is based on a screening analysis. The alternative definition process is a combination of these two processes. Defining the alternatives is accomplished by consensus among Army, OSD, and AoA Study leadership.

For MS A, the alternatives should be attribute-based and developed by the materiel developer, user, analyst, and industry.

- For MS A, the alternatives should be attribute-based. The alternatives should be developed by the materiel developer, user, analyst, and industry. The Integrated Capabilities Development Team (ICDT) should be used to go through the trades. The alternatives should be a set of attributes and should be platform-agnostic.
- For MS A, the purpose of alternatives is to determine requisite attributes.
- The knowledge at the time drives the definition of alternatives. If only concepts/technologies are available, the alternatives will be a collection of concepts and technologies rather than a full system. If the knowledge is more mature, the alternatives can be full systems. Alternatives can be foreign systems.
- For the early part of MS B AoA, there should be really good input from industry. Trades should continue. At some point, the AoA team should develop more defined alternatives/concept designs.
- The acquisition guys perform market research. There has to be communication between the PM/PEO shops and the analytical teams.

Alternatives could be a mix of different systems for the fleet. An alternative could include some new start systems for a portion of fleet and some modified systems for the remainder of the fleet.

- Sometimes alternatives can be a mix of different systems. An alternative could include some new start systems for a portion of fleet and some modified systems for the remainder of the fleet.

There are more alternatives in a MS A AoA.

- At MS A, there are more alternatives.

- There is a broad range of alternatives for AoAs

There were other points identified for the process of defining alternatives.

- The capability developer would determine if there is a nonmateriel way of meeting the gap.

- The AoA should consider all viable alternatives without giving preferential treatment to the acquisition or user community's preferred alternative.

- With the addition of the trade analysis, the level of performance of the new start alternative may not be a great as in past AoAs. The cost and available funding may constrain the level of performance attainable for a new start.

- The alternatives should be defined to show differences in operational values.

- The alternatives should be defined as much as possible early in the AoA process, although it is impossible to totally define them in the beginning. The definition of alternatives starts with the requirements. As the AoA progresses and the requirements are refined, the definitions of the alternatives are better defined.

- The level of detail or description of an alternative is somewhat dictated by the phase of the program. The alternatives have to be adequately described to allow both the cost estimators and operational/effectiveness war-gaming analysts to quantify differences between alternatives to allow comparison and trades.

- It would be nice to have guidance/rules of thumb addendum to WSARA on alternatives. The process now is ad hoc.

- If the CDD is available, the threshold and objective requirements can be used to help define the alternatives. The requirements can be traded to get different alternatives.

6. How do you think foreign system alternatives should be considered in AoAs?

For foreign systems, it is difficult to obtain the level of data needed for AoA performance and cost analyses. Foreign countries or companies are not willing to share detail data on their systems, because they don't believe the United States will purchase them. At some point, data might be available for one configuration, but not the configuration the AoA requires.

- There is a lack of good solid information about foreign alternatives. There are limited data and the analytical comparison is not "apples-to-apples." In some case, the United States does have data on the foreign system, but modifications must be made to the

system—which reduces the value of the data. Sometimes the data are only on a part of the foreign system. Usually, the foreign data have low fidelity and limited detail. Any test data from foreign countries are suspect.

- It is difficult to get the data. In some cases, the United States can't get the data.

- The AoA team would have to rely on vendor data for the cost estimates. There may have to be site visits to obtain data.

- The data for the foreign alternatives are not as available as U.S. alternatives. The data for the foreign system that may already be built may not be any better than the data for a developmental system. There is an "apples-to-oranges" relationship between the data for the foreign systems and the other systems.

- There will be more of a problem with foreign systems at MS B, because more detailed system data are required. This may be less of a problem for MS A, because we are comparing attributes. In some cases, we may not even know the attributes for the foreign systems. There is zero tradeoff work for foreign systems, because we don't know enough about them.

- The data available for foreign systems are not deep enough.

- Foreign systems are already mature, and it is not that difficult to estimate costs, providing companies are willing to share data. It can be difficult to estimate costs of foreign systems due to the lack of data. If we can obtain some cost data and technical characteristics, we can estimate foreign systems costs. It is good to have these systems included.

- Sometime there is not enough information on the foreign alternatives, and the surrogation process for data will make including the foreign alternative meaningless. The data problem needs to be solved.

- These data are needed to compare the foreign system to other alternatives.

- It is difficult to get the other countries to share the same level of information. Because the United States never selects foreign systems, the countries are reluctant to share their data.

- Potentially no data available for the configuration the United States wants to purchase. Surrogation must be used, but the surrogation must be as close as possible.

- Foreign alternatives are a huge problem, especially regarding data. It is not in the best interest of the countries to provide information to the United States, especially the detailed information that AMSAA and ARL SLAD require.

- There should be an appropriate level of data for an "apples-to-apples" comparison of the foreign alternative to the other U.S. alternatives. If the appropriate level of detail is not available, surrogations would have to be made. The AoA must be upfront with the limitations on data with the foreign alternatives. There should be a judgment of the quality of the foreign system data.

- From a cost standpoint, foreign system estimates for the life cycle are developed in a similar manner as with other systems. It is more difficult to obtain both cost and performance data for these systems, but we have been successful in the past.

- Once some of the foreign companies determine that we may seriously consider their systems, I think they will be more willing to share the cost and technical data.

Foreign systems should be identified and agreed upon early in the AoA process. The data and information request process should start early.

- Foreign systems should be identified early in the AoA process and requests for information sent out to obtain data. For the item-level analysis, detailed data are required for the foreign systems.

- The Army should aggressively pursue obtaining as much data as possible.

- An early definition of foreign systems is needed as well as a determination of what is possible for foreign systems.

The AoA team should not have the responsibility to obtain the data for foreign systems.

- The AoA team/analysts should not have the burden to get the data for foreign alternatives. There are too many foreign and exchange agreements. Maybe OSD CAPE or USD(AT&L) can obtain this data.

- The organization that selects the foreign system for inclusion in the AoA needs to ensure that the data can be acquired.

An Army PM is required to develop a notional schedule for the foreign alternative as input into the tradeoff and risk analyses.

- There would have to be a PM associated with the foreign system to develop a notional schedule, which would include testing.

All foreign systems will require some level of modification to address U.S. standards, U.S. GFE (e.g., radios), or U.S. manufacturing sites. Modifications may also be required to meet desired capability. The cost and schedule of these modifications would have to be included in the AoA.

- It is likely that all foreign systems, if selected, would have to be modified. The only real NDI systems would be U.S. systems.

- Selecting a foreign system "as is" would probably involve settling for less than what is set forth in the requirements. Modifications to the foreign systems can be included to increase capability to meet the requirements. The cost and schedule of these modifications would have to be included in the AoA.

- The foreign alternatives always require some modification. Costs and impacts of the modifications must be accounted for.

- It should be noted that foreign alternatives are not NDI alternatives. All foreign alternatives will have to be modified to be used by the U.S. and to meet U.S. standards.

- Also, the foreign systems are not really NDIs. They require significant additional modification.

- Any foreign system will have to be Americanized. Foreign systems can't just be bought off the shelf. The ammunition, radio, etc., would have to be changed meet U.S. standards. The system may have to be altered to fit U.S. soldiers. This modification of the foreign system must be included in the cost of the foreign alternative. Manufacturing in the United States or another country must be considered in the cost analysis. All assumptions need to be laid out.

- If a foreign system is selected, it would have to be built in the United States.

There are risks associated with using foreign systems such as compatibility, interoperability, and sustainment. These risks must be considered in the AoA.

- There are issues of compatibility in using foreign systems.

- The risks associated with the foreign alternatives not being made in the United States must be considered.

- A number of factors not usually considered in AoAs are important to the risk of using foreign alternatives. For example, the interoperability of the foreign system in the

U.S. Army, the fuel the system uses, recovery vehicle used for the foreign system, or special toolkits required to repair the systems. Factors such as these must be considered before the MS decisions are made.

The United States rarely buys foreign systems because of political reasons and industrial base reasons.

- The United States rarely buys the foreign alternative, but it is good to include them.

- The possibility of actually buying a foreign alternative is small, because of the political firestorm it would cause.

- Another issue is that a foreign system may not be politically acceptable. The SAG will have to eliminate systems that would not be acceptable.

- There is hesitance to use foreign systems unless they are allowed into open competition, which may not be acceptable from a taxpayer's standpoint. There is a need to build the system in the United States. The Untied States should have the capability to build its weapons systems. The United States does not want to be held captive by another country for spare parts. There have been issues in the past about not getting spare parts from other countries where the State Department had to step in to help. Another issue is that if the United States buys a system from one country, other U.S. allies may be upset at this favoritism.

- Most foreign companies selected to produce systems for the Army end up setting up facilities in this country to appease Congress and meet buy-American rules.

- It is questionable whether foreign systems are feasible alternatives—i.e., would they actually be procured? There may be industrial base concerns with purchasing a foreign system. Congress may not support procuring a foreign system, and it may not be politically acceptable.

Foreign alternatives should be considered appropriately based on the information/data available. There may be greater uncertainty in the analytical results of foreign systems. This uncertainty should be understood by the AoA customers.

- The challenge is how to make the foreign system comparable in terms of analysis.

- Foreign alternatives should be considered in the appropriate manner.

- Foreign alternatives should be considered in AoA to the extent possible in a way suitable to the information available on them. They may not be treated in a similar

manner as the U.S. systems, because of data available. The foreign alternatives may be treated with greater uncertainty.

- Foreign alternatives should be considered appropriately with the same standards as all alternatives.
- Foreign systems should be considered like any other systems that require minimal development (such as some NDI systems).
- Dealing with foreign alternatives is very complicated, but the Army must learn how to incorporate them into AoAs.
- "Fuzzy dots" are acceptable to OSD CAPE, but they tend to look at the center of the dots as the most likely point and use that as if it were quality data.
- There is never an equal understanding of foreign alternatives as for U.S. alternatives, but there are huge expectations for the analysis.

The number of foreign alternatives should be limited (one or two), because of the analytical resources needed to evaluate them.

- There should be only one or two foreign systems included in the AoA.
- Foreign alternatives should be considered in the screening analysis.
- Consideration of foreign alternatives requires analytical resources to evaluate them.

Foreign systems should not be considered if they are not viable, feasible candidates.

- Foreign systems should not be included if they are not serous candidates. The Army does not want to waste analytical resources on a throwaway system just to say a foreign system is considered.
- If a foreign system is a viable alternative, it should be considered
- If an alternative is not feasible, it should not be included.

7. How do you think the tradeoffs between cost, schedule, and performance should be considered in AoAs?

The trades are between cost, schedule, and technology. These trades would result in a level of performance. Tradeoff analyses involve parametric analyses where technologies are added or removed to the alternatives.

- The trades between cost, schedule, and technology would result in a level of performance. A mathematical representation of the tradeoff analysis would be $f(c, s, t) = p$, where c = cost, s = schedule, t = technology, and p = performance. This level of

performance developed from the tradeoff analysis would inform an AoA. AoAs typically address performance and operational effectiveness, but they don't trade technologies. Each alternative has its own level of performance. These levels of performance for the alternatives are compared during an AoA. A change in performance could be the justification for doing an AoA for MS B or MS C.

- Trades involve parametric analyses. There can be many combinations of trades by taking off or adding technologies to alternatives.

A systematic approach to the tradeoff analysis should be developed and used for AoAs.

- The tradeoff analysis is an integral part of an AoA. The analysis should be composed of a couple of steps. Phase 1 would be a parametric analysis and a capability comparison (this would be within an alternative comparison). Following this, a systems trades analysis should be conducted. There should be a systematic approach to trades and possibly a tool concept.

- After the AoA, the next MS will also include trades. For MS A, it is what the Army wants. For MS B, it is what the industry does ; for MS C, what can industry really do.

- Someone has to define what is to be traded and compared. The AoA team needs help as to what to trade.

Affordability analysis should be conducted to determine a cost target range, which can be used in the tradeoff analyses.

- For tradeoff analysis, everything should not be varied at once. There should be a cost target range, but there also should be excursions outside that range. The schedule should be varied to minimize risk.

- Affordability must be included early in the AoA process instead of after the AoA. From the affordability analyses, cost targets can be generated.

- Most of our current AoA establish a procurement cost target used to perform trades on alternatives and technologies throughout the AoA process. Both the cost analysis and operational/effectiveness analyses are iterative processes. Alternatives that cost more than the target are excluded.

The tradeoffs must be done within the context of the decision space.

- The tradeoffs must be done within the context of the decision space. There must be a balance of cost, schedule, and performance within the decision space. In the past, the

decision space was ignored to preserve the sanctity of the analysis. The analysis was very thorough, but it may not have supported the decision space.

- The Army is forced to live with the cost, schedule, and performance trades. The Army has to determine how to make the trades acceptable to OSD CAPE.

Operational effectiveness and performance analyses are required to perform the tradeoff analyses.

- Both item/system level performance and force-on-force effectiveness results are needed—although sometimes the trades are done without force-on-force analyses.
- There still are trades in the AoA, and detailed analysis will help determine what to trade.

It is difficult to consider schedule trades in the tradeoff analysis. The desired timeline for development of the system may preclude a change in the schedule. There is a lack of realistic schedule estimation, and schedule variations greatly affect cost.

- Trades can be done in performance and cost, but not so much for schedule. In previous AoAs, we have not done schedule trades—just tried to meet the given schedule. Trades are done on technologies, and the effect on cost and performance/effectiveness is estimated.
- Schedule also can be used a discriminator up front to eliminate alternatives that cannot provide capability in the desired timeframe.
- Schedule is the shortcoming. The percentage change in schedule is much higher than the percentage change in cost. The relationship between schedule and cost must be understood. The predicted change in schedule is much higher than the predicted change in cost with the element of schedule removed from cost.
- There is a lack of realistic schedule estimation. Realistic schedules will reduce the likelihood of cost and schedule breaches.

The tradeoff analysis should be done before an AoA, upfront in the AoA process or throughout the AoA process.

- Tradeoffs between cost, schedule, and technology should be completed before an AoA begins.
- The tradeoff analysis should be done upfront.
- Trades should be done throughout the AoA.

- Tradeoff analysis should not be done 6 to 9 months after an AoA.

The tradeoff analysis will become difficult with multiple alternatives to consider.

- More formal excursions can help eliminate trade candidates.

- The challenge is that, given too many alternatives, the tradeoff analysis will become burdensome. For one recent MS B AoA, there were 12 alternatives. Performing cost, schedule, and technical risk assessments on all these alternatives is time-intensive. There are too many alternatives. The Army should whittle down the alternatives to better focus on what is important for the decision-makers.

Risk assessments are part of the tradeoff analyses. The relationship between cost, schedule, and performance must be understood.

- AoAs are now considering cost, schedule, and technical risk analyses. AMSAA is performing these risk assessments.

- Risk assessment is part of this tradeoff. The relationship between cost, schedule, and performance must be understood. The sensitivity of changes in any of these factors to the others must be examined. The tradeoff analysis is an iterative process.

- Sensitivity analysis should be performed on the technology, cost, and schedule to determine the effect on performance.

Risk methodology should have different approaches to consider past systems/components and new system/components.

- The risk methodology should have different approaches to consider past systems/components and new system/components. The methodology should look into the past and to the future. It is not the same approach for the past and future estimates of risk. For the past approach, the key is the method to establish analogous systems. Information about what is known about similar types of systems must be compiled. For a new system with no analogous system, it should be decomposed into parts/subsystems. Then some subsystems may have an analogous system, and the past method can be used for risk. For unique parts, a different approach must be used. Integration should be considered.

- The DoD community is still in its infancy regarding tradeoff and risk analyses.

Tradeoff analyses allow more robust, cost-effective solutions to be developed.

- The tradeoff analysis allows the AoA team to examine a more robust set of ways to solve the problem. In the past, the AoAs typically looked at point solutions.

- The tradeoff analysis is very important and underpins decisions.

- Unlike AoA developed pre-WSARA, current AoAs factor in cost upfront. I think that is one of the key benefits of the current AoA guidance. Cost and affordability boundaries are established early in the analysis. In the past, the operational analysis was conducted parallel but separate to the cost analysis. The two analyses were combined in the final briefings and report. If the system wasn't affordable in the desired timeframe, development or procurement was stretched. Similarly, alternatives weren't always vetted for schedule realism.

The tradeoff analyses affect the requirements generation process. Tradeoffs can be used to determine the minimum requirements to reduce cost and maintain schedule. The JCIDS process also should consider trades before an AoA is conducted.

- A requirement/technology can be traded to reduce cost or schedule. The tradeoff analysis flows back to the requirements. The requirements should not be locked in early, but they should be influenced by the tradeoff analysis.

- The AoA can determine analytically what is the minimum technology and performance to meet CDD requirements and decrease cost and maintain schedule.

- AoAs inform draft CDDs, and the tradeoff analysis could help make acceptable programmatic and requirements tradeoffs. Cost is a focus on the trades.

- The JCIDS process needs to consider the trades work upfront before an AoA is conducted.

Currently, cost is the most important factor in the decision space.

- Numerous options are investigated in AoAs related to extending schedule, increasing/decreasing capability, reducing cost, etc. Currently, cost is the most important factor. Schedule also is important to get the equipment to the soldier quicker.

- For example, in 2005, the main focus was fielding systems quickly for the war. Schedule issues dominated the decision space. Currently, the cost of the systems is the most important factor.

For the tradeoff analysis, LCC should be considered rather than only procurement costs.

- For cost trades, LCC should be considered rather than just the procurement costs. The big driver should be LCC. Past AoAs have examined procurement or unit cost.

8. What would you do differently in future AoAs to better meet OSD CAPE expectations?

The Army should involve OSD CAPE early in the AoA process. The Army must understand OSD CAPE's guidance, and OSD CAPE must understand the Army's proposed study plan. The Army should be proactive in writing draft AoA guidance for OSD CAPE's consideration.

- OSD CAPE should be brought in early to the Army's AoA process.

- The Army should get OSD CAPE involved early and often.

- For future AoAs, the guidance should be understood earlier. Sometimes OSD CAPE guidance is provided one day and three days later the AoA study plan is required. Sometimes the OSD CAPE guidance is not officially approved until months later. There needs to be quicker agreement on the study plan. There should be earlier interaction with OSD CAPE.

- There must be interactions with OSD CAPE early and often.

- The Army needs to ask OSD CAPE more questions on the guidance and have a better understanding of the guidance. The Army should engage OSD CAPE to obtain an agreement or expectation on what is required in the AoA. If this is done, OSD CAPE may solidify its guidance so it does not change in the 11th hour.

- The Army should be proactive in writing draft AoA guidance and send this guidance to OSD CAPE. The Army needs OSD CAPE guidance early so it would not be "marching south instead of going north" as OSD CAPE would like.

The Army must increase the open and transparent communication with OSD CAPE during the AoA. The Army must share information and explain the analyses to OSD CAPE often during the AoA process. The Army must work closely with OSD CAPE to increase its level of understanding of the analysis so they understand that the analysis is credible and relevant.

- There should be better communication with OSD CAPE, and it should be open and transparent.

- There should be better communication with OSD CAPE to determine what they are looking for.

- Increase the dialogue with OSD CAPE during the AoA.

- The guidance from OSD CAPE is important. The Army has to share information with OSD CAPE along the way. The Army can't wait until just before an MS decision, but it must be willing to share early on.

- OSD should be included in all IPRs and meetings regarding the AoAs. AoAs should be open and transparent.

- The analysis must be transparent and open to OSD CAPE.

- For future AoAs, the Army must be transparent with OSD CAPE. engaging it on the details of the analysis—key limitations and assumptions of the analysis.

- The Army must work closely with OSD CAPE to increase its level of understanding of the analysis so the analysis is credible and relevant. OSD CAPE has to understand what is "under the hood."

- The Army must communicate with and educate OSD CAPE.

- The Army has to work closer with OSD to determine what is acceptable.

- The Army must have the ability to work well with OSD CAPE. The analysis process must be transparent and inclusive. Trust must be established in both directions. The Army has to go into the process with the expectation that OSD CAPE is in the right place and wants to do the right thing. OSD CAPE must have the same expectation of the Army.

The Army must ensure the AoA results are presented in an unbiased manner. The Army should involve OSD CAPE in the interpretation of results. There should be no preferred alternatives in AoAs.

- OSD CAPE believes the AoA team may not have the freedom to explain the results of its analyses. OSD CAPE thinks there is a kind of coercive effect on what the analyses say. OSD CAPE believes analysis may be good (i.e., quality and objectivity), but interpret the data different than how the Army does. The Army tends to compare a new system vs. the competitors, while OSD CAPE looks at a different decision choice. The Army has to involve OSD CAPE in the interpretation of results.

- For Pre-MS A, there has been an issue of an Army-preferred alternative in past AoAs. There usually is significant work associated with packaging this preferred alternative, and there would be less effort in defining the other alternatives. Resolution of detail would not be equal in defining these alternatives. It was more difficult to develop the

cost estimates, and to have the same level of quality in the cost estimates, for the nonproferred alternatives.

- In the past, all the analysis results tended to support the preferred alternative. Not having a preferred alternative would improve the quality of the analysis to support decision-makers.

AoA analyses and results must be related to OSD CAPE decision choices. The decision choices are not necessarily alternatives. AoAs must inform and enable decisions and be focused on the decision space.

- AoAs failed to speak to OSD CAPE in its language. The Army has to learn to speak to OSD CAPE in ways relevant to its decision choices. Decision choices are not necessarily alternatives. The Army has to cast results in terms of OSD CAPE decision choices.

- Army AoAs should be framed in the context of the decisions. The analysis community does not care about the outcome, and it is not a proponent for any alternative. There is no predetermined alternative.

- AoAs must inform and enable decisions. AoAs must address how to fill the gap with what is available to the Army. For the Army, the soldier is the ultimate customer.

- The AoAs must better address the decision space.

- The AoA should focus on the decision-makers' expectations. The AoA team should brief the decision-makers often to obtain their expectations and guidance and to ensure that the AoA is on the right path.

- AoAs should provide the best set of alternatives for the decision-maker.

There should be an agreed-upon set of alternatives and an established hierarchy within this set to ensure analyses are performed on them.

- There should be a hierarchy to the alternatives to ensure analysis is performed on the important alternatives.

- There needs to be an agreed-upon set of alternatives for full treatment.

- There is a lack of high-level guidance for AoAs.

- In future AoAs, well-defined alternatives would be beneficial. Sometimes alternatives are not defined to a degree to estimate LCCs.

The scope of an AoA should be reduced as it progresses. The number of alternatives should be reduced by the SAG where alternatives are no longer feasible or do not add to the decision choices. Analyses that do not add information relevant to the decision should be stopped.

- Angst and frustration arise on the scoping of the AoAs (scope can increase and get out of hand).

- AoA must be completed quicker. The AoA timeline has to fit the schedule. The strategy should be to reduce the scope of the study as it progresses. The AoA may start out with a number of alternatives and analysis planned, but at the IPRs/knowledge points, some things may be dropped off table. This reduction of scope would help the team complete the study. In the past, things (alternatives or analyses) always get added but nothing gets taken off.

- There is a point of diminishing returns on alternatives.

- AoAs should have a reasonable number of alternatives, and alternatives should not be added, but rather excursions made.

- Early excursion alternatives—there is a need to know when to stop analysis on them.

- Know when enough is enough as opposed to follow-on analysis.

- AoAs can form a life of its own (analyses breed analyses).

AoAs must explore trade space for cost, schedule, and performance. Risk assessment should be conducted for cost, schedule, and technical (including integration).

- AoAs must fully explore the trades space. The items that are open for trades should be identified.

- Cost-informed trades should be part of the AoAs.

- The AoA team has to educate the user community and COEs on the tradeoff analyses.

- Tradeoff and risk analysis need to be performed. Technical risk can be used as a screening criterion. Caution is needed, because some technology advocates may claim the TRL is higher than it actually is.

- Risk assessment should be conducted for cost, schedule, and technical (including integration). Risk analyses are done at MS A and MS B, but in more detail for MS A.

- Cost is a big issue. For future AoAs, the team should work with the users to reduce cost through the tradeoff analyses. For some systems, the question is: What can we live with?
- The cost, schedule, and performance trades/risk analysis should be part of the main analysis and not performed at the end.
- There is a lack of TRL data for AoAs. The AoA teams must rely on SMEs. Much of the cost growth in systems is due to the immaturity of alternatives, and the lack of good TRL estimates.
- There also is a risk of the performance not translating into operational reality.

A coherent, robust risk and trade methodology must be developed by the Army. AMSAA is currently working on this approach, and DASA-CE has a tool to support trades.

- AMSAA must develop a robust risk assessment approach.
- A coherent approach and methodology are needed for risk assessment. Some organization needs to be the one that says what the risk is. Manufacturing risk is difficult for foreign systems.
- Additional methodology work is needed in the cost, schedule, and performance trades and risk analyses.
- The requirements, schedule, cost, and performance need to integrate to perform the trades and risk analyses. The DASA-CE Joint Integrated Analysis Tool (JIAT) shows the results of excursions or trades. This tool would help expedite the trades analysis, and create greater cohesion with the AoA work group. DASA-CE is well situated to help with this analysis. The analysis community should take a closer look at the JIAT. More work needs to be done with the models and databases within JIAT.
- Cost goals are needed to help with the trades.

Cost methodology should be refined to develop more estimating relationships that link performance to cost, better incorporate risk, and consider affordability.

- From the cost analysis perspective, we will have to develop more estimating relationships that can link the capability/performance to cost to facilitate quicker and more accurate cost trades.
- We also have to better incorporate risk into our cost estimates.

- Affordability should be considered, especially the affordability of the life of the system. Current acquisition considers the affordability over the POM years, but does not consider O&S or disposal costs. LCCs should be considered.

Conducting formal AoAs for each MS decision would increase the fidelity and structure of the analysis and would increase the information flow for the analyses.

- More formal AoA should be conducted instead of less formal analysis. Without AoAs, analysis may not be done at each MS, there is less rigorous ongoing analysis, and analysis is not reported to formal SAGs. Having a formal AoA at each MS would allow for a constant AoA process and better flow of information.

The MS A AoA results must be used to develop the CDD.

- The CDD should not be developed before the MS A AoA is completed.
- The JROC is interested in the AoA process. It needs the AoA to support CDD decisions. The AoA would show importance in operational capability.

There are funding challenges associated with the conduct of AoAs.

- There needs to be funding to conduct AoAs. The PM/PEOs have paid in the past, but there should be some mission funding associated with AoAs.
- There are funding challenges for the conduct of AoAs.

There should be realistic schedules for conducting AoAs.

- There should be a realistic schedule associated with conducting an AoA. In the past, the AoA schedule has been accelerated too much.

The Army needs better unity of purpose.

- The Army needs to decide what we need to make decisions. Better unity of purpose within the Army is needed. Internal Army dissention should not be raised at the SAG, but rather it should have been hashed out at the Army level beforehand.
- The loss of the DUSA-OR [Deputy Under Secretary of the Army (Operations Research)] has hurt the AoA process. Before, the DUSA-OR interfaced with the OSD secretariat at the three-star level. Now the Army Staff including the G-8 and ARCIC three stars have to talk to the DOSD CAPE. The DUSA-OR had the continuity and the position on the Army secretariat. It is better to deal with OSD CAPE at the Army Secretary level instead of the Staff level.

The Army should examine Navy and Air Force AoAs that OSD CAPE believes are well done.

- Examine AoAs that OSD CAPE believes were done well.
- Learn how the Navy and Air Force are doing AoA, and what they are doing differently than the Army. We should learn from them.

Other recommendations were made to improve AoAs.

- The soldier is the ultimate customer. The objective is to get the best possible equipment into the hands of the soldier. All the stakeholders share this same ultimate goal of doing what is best for the soldiers, sailors, and marines.
- The analysis community does not have a "dog in the fight" and can recommend the best investment decision.
- Portfolio and fleet size analysis may be required in AoAs.
- Requirements should be defined so the AoA can determine if the performance meets the requirements.
- Help is needed on what to trade.
- AoAs should be done earlier (once the JCIDS process determines a materiel solution is required) and repeated later on if needed. The later AoAs would have more details.

APPENDIX B
ARMY AOA OVERSIGHT INTERVIEW RESULTS

This section provides the answers for personnel from the Army organizations DAMO-CI, DCS G-3/5/7 and ARCIC (D. Markowitz, personal communication, March 2, 2012; A. Resnick, personal communication, March 12, 2012; R. Hume, personal communication, March 16, 2012; R. Holdren, personal communication, February 16, 2012; and M. Moore, personal communication, March 2, 2012). These organizations provide oversight to Army AoAs. The answers are compiled for each question. For each question, the interviewees' answers are grouped by general ideas. A summary of the key points for all interviewees are provided followed by the interviewees' specific comments as bullet points.

1. Briefly explain in your own words the purpose of an AoA.

AoAs should support the requirements development process. AoAs should also support multiple customers in the requirements development and acquisition communities.

- AoAs help the requirements process, and the results are codified in the requirements. From MDD to MS A, the requirements are being developed. Past MS A, the specification is being developed and the program baseline is being developed in terms of cost and schedule. The AoA results feed multiple customers. AoAs assist in the approval process at MS decisions, and they are supposed to feed the ongoing process to develop requirements and specifications.

- Recent programs have knowledge points in which the AoA can help the acquisition process. The ICDT is a new team that follows the requirements through the knowledge point process.

- The use of the term "alternative" often confuses what constitutes the main purpose of an AoA. AoAs are not meant to be source selections, rather they support the requirements process and specifically the development of the CDD.

OSD CAPE is focused on supporting MS decisions with AoAs rather than supporting requirements development or acquisition processes.

- OSD CAPE is focused on supporting the MS decision process with AoAs. The organizations conducting the AoAs are focused on checking the box for the MS process rather than helping the requirements or acquisition processes.

AoAs should inform decisions regarding acquisition (including cost and schedule), requirements, and resource allocation.

- AoAs are COEAs conducted for the purpose of informing decisions regarding acquisition, requirements, and resource allocation/prioritization.

- The purpose of an AoA is to inform the decision-makers for an acquisition decision.

- AoAs also affect decisions on cost and schedule.

Formal AoAs at the later MS decisions are needed to support all the decision points throughout the acquisition process. There are too many unknowns early in the program for an MS A AoA to answer all the questions.

- Before WSARA, AoAs supported the MS B decision point. Now, OSD wants one AoA that covers all decision points (MS A to MS C). OSD wants to avoid carrying an expensive program to the MS C decision only to cancel it. The system may be canceled because it either is too expensive or can't meet the specifications. OSD wants to learn as much as possible early in the acquisition process. One AoA covering all decision points cannot achieve that vision. There are too many unknowns at the beginning of an AoA, especially if an AoA starts at the MS A decision point.

The purpose of an AoA is to develop the supporting evidence to identify an achievable, affordable, and operationally relevant set of attributes. Alternatives are the "stalking horses" to better understand the set of attributes. Alternatives are the surrogate system that allows analysis to be conducted on a set of attributes.

- The purpose of an AoA is to develop the supporting evidence to identify an achievable, affordable, and operationally relevant set of attributes. The name AoA is a misnomer, and the use of the term "alternative" is problematic. Using the term alternative implies that solutions have already been identified. Alternatives are the "stalking horses" to better understand the set of attributes. The alternatives would be used to test the concept of a particular set of attributes. The analysis is not to determine the best alternative, but to identify an achievable, affordable, and operationally relevant set of attributes.

- While designated alternative systems are used (either an existing system or a conceptual design), the alternative is used as a host or surrogate system that allows

analysis to be focused on those attributes a given system may have. Ensuring that the operational requirement is fully understood, the AoA conducts parametric trades analysis to identify the set of key attributes that are operationally acceptable (minimum necessary capability to accomplish specific mission), feasible (technology is possible in specified timeframe), and affordable (cost within established affordability target) that should be identified in the updated capability document (usually the CDD).

2. What do you think are the major issues associated with AoAs under the new WSARA guidance?

Completing an AoA at MS A is too early, but completing a detailed AoA at MS B is too late. The correct timing for an AoA is at the PDR.

- There have been multiple reforms to the acquisition process. These reforms indicate there is not a good understanding of the timing and what information is needed from AoAs. WSARA requires additional analyses from the MS A AoA. There is uncertainty on the difference between what is required from AoAs for MS A vs. MS B. Completing a detailed AoA at MS A is too early, but completing a detailed AoA at MS B is too late. The correct timing for an AoA is at the PDR. The cost-informed trades performed in the AoA need to feed the design reviews. The AoAs should not be grading the PDR results at MS decision points.

AoAs should not try to answer questions already being answered in the acquisition process (e.g., source selection).

- There is a relationship between AoAs and the acquisition strategy. AoAs should not be used for source selection, and they should not try to answer questions that the acquisition process will answer.

The requirements and acquisition communities also are customers of AoAs, in addition to OSD CAPE. AoA should benefit all stakeholders and not only focus on OSD CAPE.

- Again, the question is: Who is the customer? There are many customers of AoAs. OSD is a customer for the MS decisions, and the requirements community is a customer for the requirements development process. The acquisition community is a customer, as well as organizations that are developing fleet-mix strategies.

- The tendency of WSARA is to focus AoAs on OSD CAPE and not assist the materiel development process. AoAs should help the process and not judge the decisions.
- Establishing common view among all stakeholders regarding the purpose and scope of AoAs is a challenge.

Capability gaps and CONOPS should be developed before the start of an AoA.

- Gaps and CONOPS should be developed before materiel solution is pursued. TRADOC performs gap analysis and DOTMLPF analysis to determine if a materiel solution is required. The CONOPS begins at this time. If the gaps and CONOPS are not well defined before the materiel solution is pursued, the acquisition process may not be effective.

Timely OSD guidance and adequate AoA study plans are needed.

- Development of timely OSD guidance is a challenge.
- Development of adequate AoA study plans prior to the MDD is a challenge.
- AoAs are not cookie cutters, and they must be tailored to address the specific problems.

WSARA gave OSD CAPE more influence on AoAs, because OSD CAPE has to declare an AoA sufficient to support MS decisions.

- One major change in the WSARA legislation is that it now requires OSD CAPE to declare an AoA sufficient before a program can pass a MS decision point. Before WSARA, an AoA fell under the Title 10 responsibility of each of the Services with OSD providing oversight and policy guidance. WSARA shifts the responsibility of declaring an AoA sufficient from the Service to OSD.
- WSARA gives guidance to OSD CAPE on what it should evaluate before declaring sufficiency.
- WSARA of 2009 empowered OSD CAPE in the realm of AoAs.

WSARA specifies that the AoA should cover cost, schedule, and performance tradeoffs. Requirements can be traded.

- WSARA specifies that the AoA should cover the trade space among cost, schedule, and performance.
- There is more focus on cost, schedule, and performance trades. These are trades to requirements, and the focus is now on the requirement. There is also risk associated

with making the trades. For older AoAs, the requirements were accepted as firm. For AoAs under WSARA, the requirements must be justified, defended, and proven valid. Requirement can be traded.

Army AoAs have increased emphasis focus on measurement space and cost-benefit analyses.

- TRAC (main proponent for major program AoAs) has increased emphasis on conducting appropriate measurement space analysis at the beginning of every study. The measurement space analysis brings together the appropriate analysts, and user representatives address the following: clearly define the problem (what is the capability gap that must be addressed?); understand the capability (what capability is needed to address gaps given detailed review of operational task, condition, and standards); determine what constitutes the critical attributes; and determine trades that can be made to meet affordability targets (what can be traded to reduce cost but enhance capability). This leads to more focused trades analysis so the Army gets more "bang for the buck." In general, more emphasis is being placed on cost-benefit analysis.

WSARA has increased the workloads of the analytical community, and the Army may not have the resources (funding or personnel) to perform detailed AoAs. A central funding source should be available for AoAs.

- WSARA has increased the workload on the analytical community.
- The Army does not have the resources (funding or personnel) to perform the level of detail in AoAs. There should be a central funding source for the organizations performing AoAs.

The Army does not have enough analysts s killed in technical risk assessment, cost analyses, or affordability assessments.

- A primary focus of major program AoAs is on technical risk and costs. However, the Army does not have enough analysts with the right skills and expertise to address cost and affordability to a sufficient level of detail required.
- The Army must rely on a few organizations to perform the AoAs in order to train and develop the skilled team (e.g., AMSAA and TRAC).

3. How do you think AoAs should be tailored for different MSs?

AoA must be tailored to the specific program, requirements, and problems.

- It would depend on the program and the requirements. Before MDD, the acquisition community does not know what MS the program will enter the acquisition process.

- AoAs are not cookie cutters, and they must be tailored to address the specific problems.

The timing of AoAs is not well-coordinated with the acquisition process. Cost, schedule, and performance trades at MS A are too early and at MS B are too late; the PDR would be better timing for an AoA.

- Army AoAs are not well-correlated with the acquisition process. A detailed AoA at MS A is too early and too late at MS B. The PDR would be a better timing of an AoA. In theory, a PDR should be conducted 6 months before MS B. AoAs are used to support the yes-no MS decision process. The AoAs also are supposed to help the cost, schedule, and performance trades, but this is required earlier than MS B. For a pre-MS A AoA, the consideration of cost, schedule, and performance is too early.

It is not practical to have one AoA support all MS decisions.

- Based on OSD, there is one AoA to support all MS decisions, which is not practical. At the earlier MS decisions, there are insufficient knowledge, data, and prototypes. The performance data are assumed, because the system is not developed (no prototype) and not tested.

There should not be an AoA associated with every MS.

- There should not be an AoA associated with every MS.

- AoA should only be performed after MS A by exception. The Army does not have the resources to perform AoAs for every MS.

- AoAs are supposed to be performed for MS A and then potentially at MS B or MS C, if needed. The reasons for requiring an AoA update would be if more information is required (i.e., a deeper dive is required) or more trades need to be performed.

Before MDD, pre-AoA analyses must identify the capability gaps, threats, problems, attribute trade space, and feasible alternatives.

- For the MDD, the AoA, or pre-AoA analysis, must identify the capability gaps and threats that will form the foundation of the AoA effort.

- For an MDD, for example, the "Pre-AoA" effort must be focused on defining the problem, understanding the requirement, identifying attribute trade space, and identifying the feasible alternatives. If an AoA plan has to be approved prior to the MDD (as is the case for major ACAT I programs), the "Pre-AoA" must be started as soon as a valid requirements document is approved. More emphasis is needed to define the problem and understand the requirement.

For MS A, the AoA should inform the requirements by evaluating the cost, schedule, performance, and risk of the concepts; determining a set of achievable, affordable, and operationally relevant attributes for the system; and identifying affordable, operationally acceptable solutions.

- For MS A, the AoA should be tailored to evaluate alternative concepts through the lens of cost, performance, schedule, and risk. The AoA should also be tailored to inform the identification of appropriate requirements thresholds and objectives for KPPs and KSAs.

- For MS A, the central issue is determining a set of achievable, affordable, and operationally relevant attributes for the system, and these attributes must feed the CDD—ensuring there is a defensible basis for establishing these attributes.

- At MS A, the AoAs should assess alternatives to identify the best value set of feasible solution attributes that are operationally acceptable and affordable. This is the classic AoA that supports the requirements process and is used to refine the draft CDD.

For MS B, the AoA should identify cost drivers, conduct cost-performance trades, support CDD development, and support the PDR. The AoA should also answer the question of whether or not to build the system.

- For MS B, the AoA should be tailored to leverage information obtained from the technology demonstration activities in order to identify cost drivers; support cost performance tradeoffs; support development of threshold and objective KPP and KSA values; and support PDR. For MS B, the AoA also should be tailored in order to support the development of the Basis of Issue (BOI).

- If there is a need for an AoA at MS B (and that is an exception), the central question is to build or not to build the new system. An AoA at this MS would answer any

questions that were unanswered in the MS A AoA or if the cost or risks (cost, schedule, or performance) changed significantly.

At MS C, the AoA support provides information to support a fielding decision for the system and address affordable distribution of the system.

- For MS C, the key question is to field or not to field; the Army has the system in hand. Again, if there is driving need, the AoA could address the most affordable distribution, but this is more of an economic analysis.

AoAs should identify the cost of capabilities and how much the capabilities can be reduced to make the system more affordable.

- Cost is now a major driver and the following questions are asked: "Can we afford that much capability? How much can the capability be reduced to lower the cost of the system?" All requirements in approved documents are open to scrutiny and potential change, because the users may revisit risk, based on projected costs. It is important to establish minimum requirement thresholds to make sure the original requirement is not whittled down to the point where it is no longer worth pursuing a new materiel solution.

4. What types of analysis do you think needs to be performed in AoAs to meet OSD CAPE expectations?

Gap analyses must be conducted to provide a basis for the AoA. The AoA must assess various ways to fill the gap.

- Sound gap analyses must be conducted in order to provide a sound basis for the conduct of the AoA.

- OSD CAPE expectations are different from classic AoAs. OSD CAPE is interested primarily in validating the capability gaps. It is asking whether the proposed materiel solution is really needed. It also wants an exhaustive analysis to enumerate multiple ways to achieve a necessary capability. OSD CAPE is questioning the gaps, and it wants to make sure the gaps are valid and essential. It also wants the AoA to assess what other elements in the Joint Force can help meet these gaps.

Comprehensive cost, schedule, and performance tradeoff analyses should be conducted in an AoA. Risk analyses should also be conducted. Risk estimates can be associated with the given cost, schedule, and performance, or it can be associated with the trades.

- Comprehensive cost, schedule, and performance tradeoff analyses are essential.

- A trade space analysis of cost, schedule, and performance should be conducted in an AoA. These trades would be made on the requirements.

- Risk analysis should also be completed. One type of risk analysis is the risk associated with the given cost, schedule, and performance. Another risk examines the effect of the cost, schedule, and performance trades.

- The previous AoAs built the alternatives to requirements and then determined the cost. Under WSARA, the AoAs now trade requirements to determine performance is acceptable to meet cost or schedule objectives.

- Parametric and risk analyses should be performed in AoAs. Cost is a major part of these analyses.

- AoAs should address the risks associated with the cost, schedule, and performance of the system. The interaction of all three elements of risk must be addressed as the set of attributes is finalized.

AoAs should concentrate on determining a set of achievable, affordable, and operationally relevant attributes that mitigate an operational problem.

- The AoA should address Army needs and not just OSD CAPE needs. The Army requires a set of achievable, affordable, and operationally relevant attributes that mitigate an operational problem.

- The AoA should concentrate on the attributes (characteristics), and affordability of the system.

AoAs should develop cost estimates, including APUC, AMUC and LCC.

- The AoA must develop costs, which include APUC (or AMUC) and LCC. The AoA should also address system affordability to ensure the Army stays within its means.

AoA should not address the acquisition strategy, the number of contractors, how to build the system, or the Technology Demonstration feeds into engineering design.

- AoAs should avoid being a program management review—for example, not getting into acquisition strategy, the number of contractors, how to build the system, and the Tech Demo feeds into engineering design.

It is more difficult for the Army than the Air Force or Navy to meet OSD CAPE expectations. The Air Force and Navy's materiel solutions are more closely related to the strategic level than the Army's. OSD CAPE is more focused at the strategic level.

- It is more difficult for the Army than the Air Force or Navy to meet OSD CAPE expectations. For the Air Force and Navy, the materiel solution is more closely related to the strategic level. For the Army, the materiel solution is more closely related to the tactical level, which is several steps removed from the strategic level. The Air Force and Navy vignettes are more related to the military and defense strategy, while the Army's vignettes are more tactical. The relationship of Army vignettes to the military or defense strategy is unclear. OSD CAPE and G-3 work more at the strategic level rather than the tactical level. TRAC does not work at the strategic level for AoAs. The TAA from Center for Army Analysis (CAA) is at the strategic level, but this analysis is not associated with AoAs. Since OSD CAPE is more focused on the strategic level, the Army AoAs, which are focused on the tactical level, have more difficulty in meeting OSD CAPE's expectations.
- For the Navy, OSD CAPE is interested in the fleet needs. These needs are related closely to the National Defense Strategy and the National Military Strategy. Cost and schedule are also part of the fleet recapitalization, and cost, schedule, and performance trades may be made. Navy AoAs can address the fleet needs, because they are so closely related to the materiel solution (i.e., ships). For the Army, it is different. The Army has portfolio strategies and vehicle modernization strategies. Army AoAs don't address these portfolio and vehicle modernization issues. The organizations performing the AoAs, TRAC for example, don't work on these issues. These issues are in the realm of CAA and Headquarters Department of the Army (HQDA).
- The AoA should assure the system aligns with the new National Defense Strategy— OSD CAPE is interested in this.

5. **How do you think definitions of the alternatives should be developed?**

The definition of the alternatives should be tailored to the capabilities of the system.

- The definition of the alternatives should be tailored to the capabilities of the system. The alternatives should be tailored to the situation.

Analyses should be conducted before MDD to determine alternatives.

- There should be a set of analyses before MDD to determine the alternatives. OSD had a MDD Decision Brief Template that includes 14 issues to be covered.

Screening analysis is beneficial to determine the alternatives.

- Screening analysis is helpful to determine the alternatives.

- Screening analysis of many alternative candidates is very helpful.

Cost, schedule, and performance trades should be conducted within the alternatives.

- WSARA discusses cost, schedule, and performance trades. The trades can be done within alternatives, but AoAs need to look at trades intelligently with respect to cost, schedule, and performance depending on the maturity of our understanding of the capability. The Army does this by taking examples or cases (alternatives) and making cost, schedule, and performance trades.

Parametric analysis should be performed to determine the most important attributes.

- Parametric analysis of attributes should be performed to determine the set of most important attributes that drive capability. In turn, this supports development of more accurate cost and affordability estimates.

- Affordability must cause us to look hard at reducing attribute values. An analogy is purchasing an automobile. The buyer of an automobile identifies a set of needed attributes for a car (e.g., manual transmission, 30 miles per gallon, moderate acceleration capability, and trunk space). There also are numerous desired attributes. The affordability aspect would cut down on the desired attributes. A Volkswagen may have to be selected instead of an Audi.

AoAs should compare cases rather than alternatives. Cases are examples of alternatives.

- There is a terminology issue associated with alternatives in AoAs. The comparison in AoAs is made of cases. These cases are representative examples of alternatives. They should not be called alternatives. For example, there are cost and performance representative examples of NDI. Cost, schedule, and performance associated with these systems can be compared to other cases. These NDI cases should not modify the foreign systems.

Alternatives represent "stalking horses" to identify an achievable, affordable, and operationally relevant set of attributes. The purpose of having alternatives is to identify these attributes.

- Alternatives are the "stalking horses" to get at an achievable, affordable, and operationally relevant set of attributes. There always is a baseline alternative, which currently the Army has. The other alternatives represent groups of attributes. The AoA is about selecting a set of attributes that meet the three fundamental criteria (affordable, achievable, and operationally relevant), instead of selecting a specific alternative.

The Army should work closely with OSD CAPE to obtain agreement on the alternatives.

- Alternatives should include a baseline plus other acceptable alternatives. These alternatives should be developed collectively by the AoA team and with buy-in from the SAG. Recent AoAs have shown varied degrees of getting buy-in at the SAG. Murder boards should be conducted as well as developing systems books. These would include defining key capabilities and getting agreement of alternatives set by all members of the SAG.

- The alternatives should be locked in with OSD. They should be clearly defined and locked in before much time and effort is spend analyzing these alternatives.

- The Army must get OSD CAPE to participate more and obtain the people with the right skill sets. The Army can't keep the AoA internal, and they must let in outsiders.

6. How do you think foreign system alternatives should be considered in AoAs?

Foreign systems should be considered as equivalent to U.S. systems with the same fidelity of data.

- Foreign systems should be considered equivalent to other systems in AoAs.

- There should be the same fidelity of data for the foreign systems, so there is not an "apples-and-oranges" comparison based on data. If the foreign systems do not have the same level of data, it would be difficult to compare the alternatives.

- Viable foreign system alternatives should be included in AoA.

Foreign systems represent NDI cases. Therefore, they should not be modified.

- Foreign systems are representative of NDI cases. They have a cost and performance associated with them. There is cost, schedule, and performance associated with these

systems that can be compared to other cases. These NDI cases should not modify the foreign systems.

The United States may not purchase a foreign system for statutory reasons.

- The question is : Why should foreign system be considered in AoAs? There are laws that preclude the United States from buying foreign systems. Foreign system manufacturers may go into business with U.S. companies to sell the system.

- Even foreign-developed systems would be manufactured in the United States. The United States would have to be willing to buy the foreign system, but there is no political will at this point.

Foreign systems should only be considered in AoAs for comparison purposes only to investigate capabilities and attributes.

- Unless the United States is seriously considering buying the foreign system, having a foreign system in the AoA is for comparison purposes only. Analyzing the foreign system would be beneficial to examine its capabilities and determine if they would be useful on the U.S. system.

- Foreign systems should only be included as an exception and only to help identify a set of attributes.

- Foreign systems would be good for competition. For the "concept car," foreign companies could be invited.

Foreign systems will have to be modified to meet U.S. standards.

- At a minimum, the foreign system will have to be changed to adapt to U.S. military standard.

Foreign systems should be discussed with OSD CAPE early in the AoA process to determine how they will be considered.

- Foreign system alternatives should be discussed early with OSD CAPE. The AoA team must clearly define how they are considering the foreign systems in the AoA. This discussion of foreign systems will help set the parameters of the analysis.

A "concept vehicle" approach to developing systems could enhance AoAs.

- Having a "concept vehicle" would allow more data to be collected and a better comparison made. Developing concept vehicles early in the process will allow performance data to be collected. These concept vehicles can be compared to the

current combat vehicles. The big advantage would be that the Army is not committed to buying any of the concept vehicles into a full production model. The Army only buys the concept vehicles. If the concept vehicles look promising, the Army can invest more money in conducting an AoA. If the AoA concludes the concept vehicles are better than the current vehicles and that the cost to replace the current vehicle is acceptable, then the Army can develop prototypes for competition.

7. How do you think the tradeoffs between cost, schedule, and performance should be considered in AoAs?

Tradeoff analyses should be tailored to the capability, maturity, and cost of the system.

- It depends on the capability, maturity, and cost of the systems.

Trades should be performed within and among alternatives to address the decision space.

- For early in the process of defining alternatives, the cost, schedule, and performance trades should be done internally within the alternative. Cost, schedule, and performance trades should be considered in the AoA prior to MS A and post MS A. Sensitivity analysis should be conducted to address the among-alternative trades (i.e., the inter-alternative trades). Both the within and among trades have to be performed to address the decision space.

The tradeoff analysis will support the requirements development process, including the needed attributes.

- The trades should be associated with requirements. The requirements drive the cost, schedule, and performance. For schedule, the requirements drive the TRL and the time to mature the technologies. This maturation time is a factor in the schedule length. The "Cost-Informed-Trades" effort is along the lines of what WSARA is looking for.
- The trades have to arrive at the minimum needs.
- The classic purpose of an AoA, at the end of the day, is to determine which attributes are important.

Risk assessment should be performed on tradeoffs between cost, schedule, and performance.

- Risk assessment can be done on the effects of the trades.

- Tradeoffs of cost, schedule, and performance should be addressed in AoAs in terms of risk—what is risk to cost, schedule, and performance ? To add value, AMSAA is performing risk assessments in AoAs. Determining if technologies are not feasible in the time frame is important.

There were differing priority of factors—including cost, schedule, and performance; and performance, cost, and schedule.

- Cost, schedule, and performance should all be considered. Cost is the first among equals—an affordable alternative is paramount. Cost targets, in terms of APUC, AMUC or LCC should be identified (APUC is the best). After the cost targets are identified, the other two items (schedule and performance) are traded. Schedule is next in importance. The question is: What is the Army willing to accept to get the system in the hands of the soldier quicker? These tradeoffs must be laid out analytically.

- Technical/performance ought to be at the top of the list when trading cost, schedule, and performance. Cost is becoming increasingly important. Schedule, while important, may be a lesser priority than the others, because of uncertain thresholds and needs.

8. What would you do differently in future AoAs to better meet OSD CAPE expectations?

AoAs must address the decision process and provide utility to the decision-makers.

- The AoAs must be tied to the decision process that matters.

- AoAs must do more than offer up results that the community intuitively knows. AoAs must provide more utility to decision-makers.

AoAs must satisfy all the customers including OSD CAPE, the acquisition community, the requirements community, and the portfolio mix community.

- The AoA must satisfy all the customers including OSD CAPE, acquisition community, the requirements community, and the portfolio mix community. Knowledge points would help integrate AoAs and provide Army and OSD senior leaders better information.

AoAs must address OSD CAPE guidance and issues.

- Continue to ensure that the AoA team effectively addresses all OSD CAPE issues documented in the AoA guidance and identified during SAG meetings.

- Also, continue to ensure that results of Army analyses and results regarding OSD CAPE issues are documented in the AoA report.

The Army must engage OSD CAPE in earlier in the AoA process. The Army must be candid and open with OSD CAPE.

- One key is to bring OSD CAPE in earlier and to get their buy-in early. The Army has to be candid with OSD CAPE. To reduce the number of questions OSD CAPE asks later in the AoA process, the Army should work with OSD CAPE to lock in the defining problems. The SAG should be used to provide azimuth checks to make sure the Army is where it ought to be.

The AoA guidance should only include three points: (1) the purpose for the AoA; (2) when the AoA results are needed; and (3) identify the key angst/friction/concern points or issues.

- Too much time is spent framing the problem. The process of framing the problem is too bureaucratic and backward. The TRADOC COEs know when they are developing the CDD, which must serve as a trigger to initiate the AoA. ARCIC, armed with the when and why (the gap to satisfied), should communicate with Army staff (e.g., G3 and G8), as well as OSD AT&L and OSD CAPE. There must be an enforced timeline of approximately 30 days to frame the problem and publish the directive. The directive allows the study agency access to other organizations to help with the study. The AoA directive, or guidance, should only include three things: (1) the purpose for the AoA (why, typically, a MS designation); (2) when the AoA results are needed; (3) identify the key angst/friction/concern points or issues. The directive/guidance should not consider other areas that are typically included. Everyone would benefit with only these three points in the directive/guidance.
- The Army must do more to drive OSD CAPE to provide AoA guidance much earlier in the process.

Army requirements must be developed with the support of analyses.

- Requirements are being developed without analysis. The JCIDS process is too vague. The PMs have great latitude of what to include in the system specs. Sometimes there are interactions between the user and the PM independent of the AoAs. This may cause internal disagreements.

The Army needs more analytic capability to address AoAs.

- The Army needs to build more analysis capability, especially within COE Capabilities, Development and Integration Directorates (CDIDs). They could perform more analysis instead of TRAC, or add depth to TRAC-led AoA efforts. The Army also has to build analysis in the cost area, especially in TRADOC. Risk assessment methodology must be codified in AoA policy and regulatory guidance and directives.

- The Army should spend more time defining parameters, checking assumptions, and examining emerging data.

The Army could utilize a "concept vehicle show" for industry to demonstrate their technologies.

- The Army can learn a lot from the process industry uses in developing and marketing new vehicles. The Army should host an annual "Concept Vehicle Show" similar to the "Detroit Auto Show." The Army would need to spend RDT&E money to fund the concept vehicles. The concept vehicles would need to be actual replicas of a combat vehicle system, so the Army could collect performance data. These data could be used to develop a "systems book" for modeling the concept vehicle in the Army's combat models. There would be no obligation for the Army to buy any of the concept vehicles it develops. The purpose of the annual event is to allow industry to demonstrate what it could produce in the near future. The Army could use the data to compare the concept vehicle against the current set of vehicles to determine whether buying the new system is appropriate. It may be better to keep the new systems "on the shelf" for the future. If the AoA concludes the concept vehicles are better and the cost is reasonable, the Army can release a Request for Proposal (RFP) for industry to develop competitive prototypes for source selection. This may, or may not, add time to the acquisition process. The answer might depend on when you start the clock. If you assume the Army will always host an Annual Concept Vehicle Show, after 3 to 5 years, the Army should have plenty of concept vehicles from which to use as a starting point, which should shorten the overall length of getting a program through the acquisition process. If there are no concept vehicles to use a starting point, acquisition timeline would be longer.

APPENDIX C
OSD CAPE INTERVIEW RESULTS

This appendix provides the answers for the OSD CAPE interviewees (S. Comes & E. Simmons, personal communication, April 1, 2012; K. Kaspersen, personal communication, February 21, 2012; J. Duke & E. Fulmer, personal communication, February 24, 2012; C. Allen, personal communication, March 25, 2012). For each question, the interviewees' answers are grouped by general ideas. A summary of the key points for all interviewees is provided followed by the interviewees' specific comments as bullet points.

1. Briefly explain in your own words the purpose of an AoA.

There are numerous purposes to AoA, including providing information to inform acquisition decisions, exploring the trade space of cost schedule and performance, and answering the "Why" questions.

- To ensure that leadership has the information to make acquisition decisions.
- To inform acquisition decisions.
- Providing information for making investment decisions.
- To answer the question "why" Is it the right time to acquire the materiel solution? Does the materiel solution meet the right purpose and fill the capability gap?
- Exploring of the trade space between cost, schedule, and performance.

There are desired characteristics of the options and alternatives including: objectivity, nonpreferential options, affordable alternatives, and a robust set of alternatives.

- The AoA should be objective without a preferred option.
- The AoA should provide feasible alternatives utilizing an upfront screening analysis to ensure they are affordable and to mitigate the capability gaps. A robust set of alternatives should be considered. If two or three alternatives are not included, the analysis may be questionable.
- The AoA provides a range of options and the cost, schedule, and performance of each option.

The analyses should back up a recommended solution, show due diligence, explain the trade space, include sensitivity analysis, and consider the positive and negative aspects of each option.

- The analysis must back up a recommended solution. The AoA should answer why a particular solution is recommended.

- The AoA has to show due diligence in the analysis of the options and alternatives.

- The AoA does not have to produce a clear answer, but options with different costs and development schedules.

- The AoA should explain the trade space. The AoA should provide trades within and across alternatives among cost, schedule, and performance. "Within" alternatives include subsystem trades for differences in capability and "across" includes variations at a system level.

- The AoA should include a sensitivity analysis to help determine importance. This analysis should identify cost and performance drivers.

- The positives and negatives of each option should be explored.

The results of the AoAs should inform requirements, identify cost-effective solutions, be transparent, and consider operational effectiveness.

- The AoA should inform requirements. Although the goals may be the CDD values, sensitivity analyses should determine a decrease in the performance by 10 percent and determine the resulting cost reduction.

- Requirements cost must be identified, and the JROC must estimate how much the system will cost based on their requirements. The most cost-effective solutions should be identified.

- The AoA process should be transparent and include a rigorous and complete analysis of the alternatives. OSD CAPE requires an understanding of the analyses.

- The quality of the end results should include an impact on operational effectiveness metrics—this analysis should include results from a combined arms operational simulation.

- AoAs should include graphs that plot blue effectiveness with cost. Graphs could include separate effects for their cost.

2. What do you think are the major issues associated with AoAs under the new WSARA guidance?

OSD CAPE has an increased level of responsibility for AoAs under WSARA, that includes the following: issuing AoA guidance, determining if the AoA was performed consistent with OSD CAPE's guidance, and recommending AoA updates.

- Under WSARA, OSD CAPE provides the guidance and also determines whether the AoA was done in accordance with the guidance.

- Before WSARA, USD(AT&L) sent out the AoA guidance, although OSD CAPE developed this guidance. After WSARA, OSD CAPE develops and issues the guidance for AoAs. The change has allowed OSD CAPE more influence in the AoA guidance.

- AoAs have to be prepared consistently with OSD CAPE guidance, and CAPE has to certify that the AoA was prepared consistently with OSD CAPE guidance.

- OSD CAPE has more responsibilities for AoAs. It required a dynamic AoA update for a recent Army program.

There is a new requirement under WSARA to perform cost, schedule, and performance trades. AoAs must ensure that the trade space is explored in detail.

- WSARA includes language requiring a comprehensive look at the trades between cost, schedule, and performance.

- A major change in AoA is explaining and documenting the trade space between cost, schedule, and performance. Decision-makers should have a better understanding of the underlying problems with cost, schedule, and performance. AoAs must ensure that the trade space is explored in detail. Circumstances change, and there may be a different "lever that is more suitable to pull." There may be more flexibility to change a new system than an existing system.

WSARA has increased the visibility of AoAs, which has resulted in a greater awareness and interest in AoA results. The JS, the Services, Congress, and GAO are inquiring about the results of AoAs.

3. How do you think AoAs should be tailored for different MSs?

An AoA is required at MS A and there is one set of guidance, which is good for all MS decisions. The guidance will supply questions to be answered, and the AoA team should answer the questions to their best ability with the information available.

- There is only one AoA required and one set of AoA guidance. The guidance is to be issued at the MDD.

- OSD CAPE provides one set of AoA guidance for the acquisition effort, which is good for all MS decisions. The guidance will supply questions to be answered. The AoA guidance is due at MDD, but OSD CAPE may not know where the DAE will start the program in the acquisition process. The AoA team should answer the questions to its best ability with the information available. The AoA team may not be able to answer all questions, but it must document why it cannot answer the questions.

An AoA does not have to be updated for the subsequent MSs unless OSD CAPE designates an update is required. An AoA may have to be updated for the following reasons: (1) the underlying assumption/facts change, (2) a new threat is identified, and (3) the program changes acquisition categories that change the MDA (e.g., from the AAE to the DAE).

- The AoA does not have to be updated for the subsequent MSs unless OSD CAPE designates an update is required. Certain factors would require an AoA update. If an updated AoA is not required, the Services still would conduct informal analysis to support the acquisition process. A formal AoA may not be required.

- OSD CAPE may request an update of the AoA to answer the questions that could not be answered in the original AoA.

- An AoA may have to be updated for the following reasons: (1) the underlying assumption/facts change, (2) a new threat is identified, and (3) the program changes ACATs that change the MDA (e.g., from the AAE to the DAE).

- Reasons for updating an AoA would include a threat change, affordability or cost estimates change, the requirement change, performance change, or some other change that invalidates the analysis. There are no set percentages associated with these changes to require an update on the AoA. On a case-by-case basis, the determination is made whether an AoA update is required.

- An update of the MS A AoA may be required if the threat changes or the technology changes.

AoAs may be required at later MS decisions for (1) program going directly from MDD to MS B or post-MS B or (2) a program that changes ACAT levels.

- If the MDA determines that the program will go directly to MS B, there usually are fewer alternatives, better confidence in the cost estimates (should have APB cost), more real-world data available (prototype testing), and more information on developmental risk.

- For MS A, the alternatives are not as firm as in AoAs conducted at later MSs. There will be more detail if a MS B AoA is required.

- There could be instances where an ACAT II program increases in scope to an ACAT I program in later MSs. The movement of the program to an ACAT I status would require an AoA to be performed. AoA-like analyses should have been performed for the earlier MSs which could be used in the formal AoA.

AoAs should be tailored to the specific program rather than for the MS. The analyses are tailored for the particular program rather than for the MS.

4. What types of analysis do you think need to be performed in AoAs to meet OSD CAPE expectations?

The analysis should be quantitative instead of qualitative judgment-based. Using Subject Matter Experts (SMEs) to determine how much they desire a particular attribute, scoring the results, and developing weighing factors are not the correct process.

- Analyses should be quantifiable instead of qualitative judgment-based analyses (i.e., value-focused thinking). Using SMEs to determine how much they desire a particular attribute, scoring the results, and developing weighing factors are not the correct process. Making these qualitative results quantitative also is not appropriate.

- The analyses should be quantifiable and based on engineering and test data. For a recent AoA, various alternatives were operated, and the data were recorded.

The analyses must be understandable, transparent, and support the conclusion.

- The analyses should be understandable, transparent, compare alternatives, provide rationale and support a conclusion. The quality of the analyses should be high.

- The analyses should be transparent. OSD CAPE should not have to conduct forensics to determine how the analyses were performed.

Exploratory analysis and cost, schedule, and performance trades are important components to an AoA.

- The analyses should be exploratory.
- There should be a trades analysis of cost, schedule, and performance. These trades should be within and across.
- The analysis should provide the basic knowledge for the decision-maker with the trade space explored.

Sensitivity analyses should be performed for the assumptions, alternative definitions, and drivers. For the "lesser" alternatives, sensitivity analyses should be performed to determine what it would take to make it a more competitive alternative.

- Analyses should be performed to determine the sensitivity of the results to changes in the assumptions. The AoA should identify where the assumptions degrade and when this degradation matters or does not matter.
- For the "lesser" alternatives, sensitivity analyses should be performed to determine what it would take to make it a more competitive alternative. The AoA should address potential ways a lesser alternative could be improved. The sensitivity should address an increase and decrease in performance.
- Sensitivity analysis also should be performed to determine the sensitivity to drivers.
- Caution must be used for selecting scenarios. A scenario may drive the answer.

The analyses should identify "tipping points" for the decision choices. If there are no tipping points, or points of interest, the AoA should "stop drilling" when the result does not make a distinction between alternatives.

- The analyses should find the tipping points and points of interest.
- If there are no tipping points, or points of interest, the AoA should "stop drilling" when the result does not make a distinction between alternatives.
- If an analysis makes no distinction, OSD CAPE does not want research for academic reasons. The Service should go back to SAG and cease work on that analysis. Also, the AoA should not map out nonviable solutions.

The following analyses should be conducted in AoAs: operational effectiveness, operational assessments, performance, cost, sensitivity, fully burdened cost of fuel, and affordability/portfolio.

- The basic types of analysis should be conducted, such as cost, performance, mission effectiveness, sensitivity, and fully burdened cost of fuel.

- The specific types of analyses performed for AoAs will depend on the program. Analyses should be tailored to the particular program. In some cases, systems level analysis (i.e., engineering level analysis) may be good enough. There should be an operational effectiveness analysis and a comparison of operational effectiveness vs. cost. The AoA has to put the system in the war fight.

- Technical performance analysis should be included in the AoA, which includes measures and metrics. An operational assessment should be included to estimate how effective the alternatives are. In some cases, this operational assessment is a map exercise or a tabletop exercise with an After Action Report.

- Cost must be put into the context of affordability (i.e., portfolio analysis).

- Capability metrics can be used to determine if the alternative is better than the baseline. Specifications are too specific.

- Non-materiel solutions should still be considered.

5. How do you think definitions of the alternatives should be developed?

The basic alternatives for AoAs include a baseline of what is currently programmed in service, a modification of what is currently in service, an NDI system/foreign system, and a new start system.

- The definitions for the basic alternatives are usually clear and include the following: what you have in the inventory today, a modification of what is available in the inventory today, a new system, or something else that is available.

- One alternative should be the program or system that is funded today (i.e., the baseline). A foreign alternatives that also exists today should be included, if feasible.

- There should be a baseline of what is currently programmed for the Service. The other alternatives should have better capability based on the gaps. Another alternative should be a modified baseline. A new start can be another alternative. There should also be an NDI system.

There should be a broad search for alternatives, and the definition of those alternatives should be kept broad. The Service should not presuppose an answer and prematurely reduce the decision space.

- The alternatives should be general, and they should not be overly prescriptive. The Service should not presuppose an answer and close the aperture too quickly. If an answer assumed is too quickly, the Service may be left with no options if that answer is not feasible. The Services should not to prematurely reduce the decision space. The search should be kept broad until the information dictates that the search converges.

A robust screening analysis should be completed up front and presented to the SAG, which will request additional excursions and reframe or expand the analysis, as necessary.

- A robust screening analysis should be completed upfront. Initial results of AoA will be presented to the SAG, which is led by OSD CAPE. The SAG will request additional excursions, and reframe or expand the analysis, as necessary.

The alternatives should cover the decision space, and trades and sensitivity analyses should be performed. A good screening analysis would help explore the trade space.

- The alternatives should cover the decision space, including the end points and some points in between. End points would include the baseline and a new start. There should be not only two alternatives, but some points in between the baseline and a new start. These in-between points would help explore the trade space. In addition to the alternatives, the AoA must look at trades within the possible alternatives.

- A good screening analysis would help explore the trade space. This analysis should identify the cost and performance drivers, and determine the alternatives.

- The alternatives should provide a range of how quickly the system is available.

- In the AoA, variations of these basic alternatives must be examined in sensitivity analyses.

The Services should follow the OSD CAPE study guidance when developing alternatives.

- The Services should look at the OSD CAPE study guidance to develop the alternatives. The alternatives must address the gaps and constraints.

- The OSD CAPE guidance provides information on the alternatives.

6. How do you think foreign system alternatives should be considered in AoAs?

Foreign systems should be considered in AoAs, and the Services should do their best to obtain data and information. Systems from threat countries should not be considered.

- Foreign alternatives should be considered in AoAs.

- The consideration of foreign alternatives is difficult. The Services should do their best to investigate the foreign alternatives. They can obtain a vehicle or visit the country.

- The OSD CAPE guidance would include foreign systems. How the foreign systems are considered depends on the specific AoA and program.

- The foreign government may not share the technology. There should be enough foreign system data to conduct the initial screening. It is questionable if enough data would be available to perform the AoA, but it is the SAG decision to not consider the foreign system if enough data are not available.

- Since the foreign alternative exists, there should be actual test/fielding data available.

- Foreign systems should stand on their own merit, and they should be explored. There are some countries where foreign alternatives should not be considered in an AoA. On the other hand, alternatives should not be thrown out just because they are foreign. The Service cannot jump to only U.S. systems.

- Feasible foreign alternatives should be considered in the AoA, which includes systems that meet the capability gaps with affordability. Systems from some countries may not be feasible.

The decision to actually purchase a foreign alternative is not OSD CAPE's or the AoA team's decision.

- The question of whether DoD actually will purchase the foreign alternative is someone else's decision besides OSD CAPE or the AoA team.

The cost and time associated with modifying foreign alternatives should be considered in the AoA.

- There will be cost and time associated with the certification and modification of the foreign systems to be used in the U.S. military. This additional cost and time should be considered in the AoA. The AoA should identify drawbacks.

Another purpose of considering foreign alternatives is to learn more about their features, attributes, technical feasibility, and cost.

- Foreign systems could be used to identify desirable features/attributes that can be used in U.S. systems.

- By considering the foreign alternatives, the Services will learn about technical feasibility, performance, or cost.

- Foreign alternatives, if selected, would be fabricated in the United States. Some U.S. corporations are worldwide, and they leverage the knowledge of the foreign systems or build the foreign systems.

7. How do you think the tradeoffs between cost, schedule, and performance should be considered in AoAs?

The tradeoff analysis should explore the trade space and decision space for AoAs. The boundaries for the trade space should be expanded to ensure a robust decision space. The trades should be explored throughout the AoA.

- The tradeoff analyses should explore the trade space between cost, schedule, and performance.

- The AoA should show the implications of the trades. The parameters should provide information in the "infeasible" zone. For example, if the Service's schedule limit is 7 years, but a much better weapons system could be produced in 8 years, this should be identified in the AoA.

- The trades should not be locked down prematurely, and the boundaries should be expanded. OSD CAPE does realize there analytical capability is not unlimited.

- The trades should be explored throughout the AoA.

- For a good tradeoff analysis, some specific attributes should be varied. The biggest benefit to the tradeoff analysis is to create a robust decision space and to ensure completeness of the analysis. Some attributes may be varied outside the practical limits to see what the effect would be. This consideration could expand the decision space.

AoAs should include performance vs. cost curves.

- There should be performance vs. cost curves developed in the AoA. The tradeoff analysis is looking for the knee in the curve of performance vs. cost. A system with the best performance but a very high cost may not be desired.

The priority of tradeoff factors are performance, schedule, and then cost.

- The priority of the tradeoff factors is performance, schedule, and then cost. The AoA must first ensure the performance is worth it. The AoA must determine what performance level can be obtained for each option and then determine if this capability is important. Schedule is the second priority. Schedule drives cost. Optimistic schedules may have no chance of succeeding, and the additional time required would increase cost. The AoA must ensure the schedules are realistic. Cost is important, but not as important as the other two factors.

Operational effectiveness is needed in the tradeoff analysis, and the CAIG should be included in the cost estimates.

- The independent cost organization (CAIG) should be involved early in the AoA process. They can help identify the real cost, and whether the system is worth the cost.
- The effectiveness of the alternatives is what OSD CAPE desires.
- The system level attributes should be mapped to operational effectiveness. The tradeoff analysis should include operational effectiveness runs.

AoA should inform the CDD; although the CDD should not be written to make one alternative appear better.

- AoAs should inform the CDD; although the CDD should not be written for the preferred alternative (the preferred alternative going into an AoA). The CDD should not be changed to make one alternative look better.

8. What would you do differently in future AoAs to better meet OSD CAPE expectations?

OSD CAPE desires more transparency, visibility, understanding of the analyses and assumptions.

- OSD CAPE desires better visibility into the AoA and a better understanding of the assumptions.
- OSD CAPE would like the analysis to be taken up a level (i.e., the drivers of the results should be explained). More visibility should be provided as to why a certain alternative was rated "Red" for a given analysis. The AoA should identify what is driving the answers.

- Insight into the assumptions is critical. Sometimes the AoA team makes choices that could drive the assumptions and results.

- There should be good communication between the Services and OSD CAPE.

- The analyses have to be transparent.

AoAs should not focus on one preferred alternative. The preferred alternative may not be attainable or viable, and a program based on this alternative may be canceled in later years.

- AoA should not be focused on one alternative for the solution. This one solution may not be attainable or viable, and a program based on this solution may be canceled in later years.

- The Services should not prematurely constrain trade space. Locking down too early will restrict flexibility.

The following items should be included in AoAs:

- Cost-effectiveness analyses

- Real world test results

- Real world foreign alternatives

- Early identification of cost and performance drivers

- Operational effectiveness to cost graphs

- Sensitivity analyses on the assumptions

- Consideration of the resources available, requirements, and acquisition process

Cost and schedule should be considered when developing requirements.

- The JROC should consider costs when developing requirements.

- For the requirements, the "no kidding" minimum values for the requirements should be identified. The requirements should be realistic so the program is not trying to produce an unattainable solution. The cost should be considered when developing these requirements. Also, scheduling aspects should be considered.

AoAs should be streamlined to reduce the cost of conducting the AoAs.

APPENDIX D
ADDITIONAL RECOMMENDATIONS FROM INTERVIEWS

This appendix provides additional recommendations to better meet OSD CAPE expectations, better meet other AoA customer expectations and improve the usefulness of AoAs. These recommendations were taken from the Army and OSD CAPE personnel interviews. The five key recommendations are included in Chapter 5.

General Recommendations

- The AoA guidance should only include three points: (1) the purpose for the AoA; (2) when the AoA results are needed; and (3) identification of the key angst/friction/ concern points or issues.

- Ensure the AoA analysts have a better understanding of their customers, stakeholders, and external operating environment.

- AoA should not address the acquisition strategy, the number of contractors, how to build the system, or the Technology Demonstration feeds into engineering design.

- Investigate the use of a "concept vehicle" approach to developing systems and a "concept vehicle show" for industry to demonstrate its technologies.

Alternative Related Recommendations

- Perform a detailed screening analysis to perform a board search for alternatives. The screening analyses should start with a broad look for possible alternatives and reduce these alternatives based on criteria.

- For the MS A AoA, obtain input from industry as to what technology or systems are available.

- Limit the number of alternatives that go through a full suite of analyses to six or fewer. Out of these six full alternatives, have at most two foreign alternatives. Tradeoff, sensitivity, and parametric analyses can be conducted on these six alternatives to further explore the trade space.

- The alternatives should be a set of attributes and should not be related to a certain system or platform.

- Identify an organization outside the Army AoA community to obtain data on foreign systems.

- Assign an Army PM to develop a notional schedule for the foreign alternative as input into the tradeoff and risk analyses.

- The AoA should identify all modification that would be required for a foreign system to operate in the U.S. Army : Address U.S. standards, U.S. GFE (e.g., radios), or U.S. manufacturing sites. Modifications also may be required to meet desired capability. Include the cost, schedule, performance, and risk implications for these modifications in the AoA.

- The AoA team should recommend to the SAG that alternatives be eliminated if they are no longer feasible or add nothing to the decision choices.

Analyses Recommendations

- For AoAs that have OSD CAPE oversight, the Army should ensure that all analyses is quantitative-based instead of qualitative judgment-based. OSD CAPE is not in favor of SME-based value assessments.

- The AoAs should focus on other analyses besides effectiveness, including sustainment, force structure, transportability, and DOTMLPF.

- While conducting an AoA, the analyses that do not add information relevant to the decision should be stopped.

- The analyses should identify "tipping points" for the decision choices. If there are no tipping points, or points of interest, the AoA should "stop drilling" when the result does not make a distinction between alternatives.

- For the concept design, the Army needs first-order estimates that are rapidly developed without the detailed design. Performance and cost estimates will have to be made for the evolving concept designs, which are due to trades.

- AoAs should include affordability-portfolio assessments.

Tradeoff and Risk Analyses Recommendations

- Develop a coherent, robust risk and trade methodology. The methodology must address the relationship between cost, schedule, and performance. The interaction of the tradeoff and risk assessments also must be developed. AMSAA currently is working on this approach, and DASA-CE has a tool to support trades.

- The boundaries for the trade space should be expanded to ensure a robust decision space.

The trades should be explored throughout the AoA.

- Tradeoff analyses should be conducted across and within alternatives and at the system and subsystem levels.
- Frame the tradeoff analyses for cost, schedule, and technology. Technology is the physical aspect of the performance trade.
- Risk assessments should be framed in the context of cost, schedule, and technical risks.
- Risk methodology should have different approaches to consider past systems/ components and new systems/components.
- Risk assessment should be performed on tradeoffs between cost, schedule, and performance.
- Include operational effectiveness to cost graphs and performance vs. cost graphs in the tradeoff and cost-effectiveness analyses results.
- The AoA should include parametric or sensitivity analyses on "lesser" alternatives to determine if they could be made more competitive.

Cost-Related Recommendations

- Use O&S and LCC in AoAs, specifically for the tradeoff analyses.
- Refine cost methodology to develop more estimating relationships that link performance to cost, better incorporate risk, and consider affordability.
- The Capability Knowledge Base should be populated with ACAT II and III data.
- The CAIG should be included in the development of cost estimates.

Resource-Related Recommendations

- Establish a funding site for the organizations that conduct AoAs (e.g., TRAC, AMSAA, DASA-CE, and ARL SLAD).
- Train additional analysts for technical risk assessment, cost analyses, and affordability assessments.
- AoAs should be streamlined to reduce the cost of conducting the AoAs.